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HANDYMAN ENCYCLOPEDIA

13

PANELS

PICTURE FRAMING

DO-IT-YOURSELF

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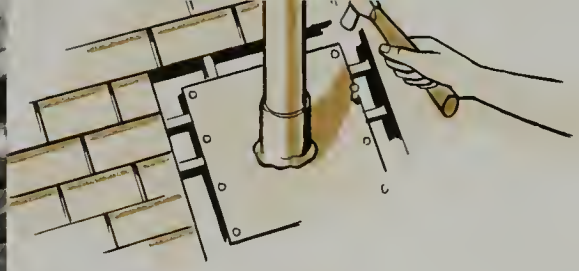

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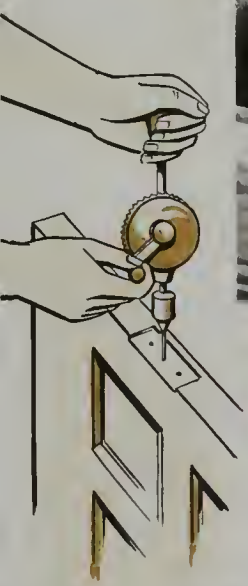

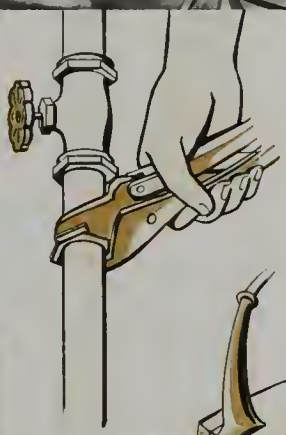

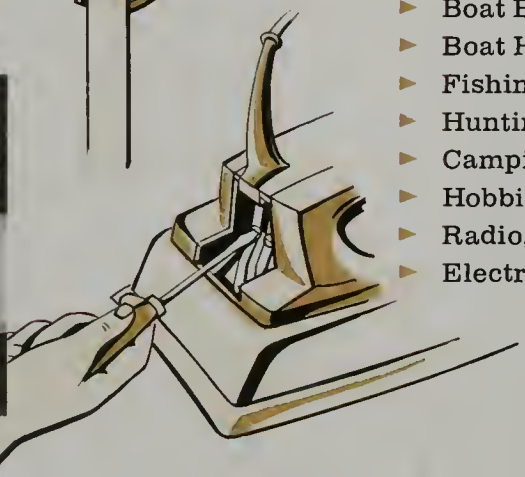

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Complete Handyman yourself Encyclopedia

A COMPILATION OF NEW AND PREVIOUSLY PUBLISHED SPECIAL INTEREST PROJECTS AND MANUALS FOR THE REPAIR AND CARE OF HOMES, AUTO, APPLIANCES, HOBBY EQUIPMENT.

by the editors of

Science & Mechanics

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PANELS

PICTURE FRAMING

H. S. STUTTMAN CO., INC. *publishers* Westport, CT. 06889

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ISBN 0-87475-700-2
Library of Congress Catalog Card No. 74-21375

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PRINTED IN THE UNITED STATES OF AMERICA

13P(0268)25-396

VOLUME 13

PANELS

HOW TO INSTALL WALL PANELING: You can use a variety of materials—prefinished plywood sheets, solid boards, enameled panels, or even fiberglass—to replace old walls with new, or build them from scratch in new construction 1855

HOW TO BUILD WITH TRANSLUCENT PANELS: Roofing a patio or erecting a translucent fence are only two of the many projects you can complete with easy-to-use panels of durable, maintenance-free fiberglass 1881

PAPER DISPENSER, KITCHEN

BUILD A KITCHEN PAPER DISPENSER: It only takes a few hours to make this unit which will keep tissue, foil, towels and the like out of sight but at your fingertips 1891

PARSONS TABLE

HOW TO MAKE AND COVER A PARSONS TABLE: This handsome modern table is not difficult to make. You can cover it with fabric, as shown here, or finish it in some other way if you choose 1894

PARTITIONS

HOW TO MAKE SPRING POLE PARTITIONS: These versatile devices can be used to erect room dividers or support shelves or construct a new wall quickly without elaborate framing 1900

PARTS REPLACEMENT, ENGINE

HOW TO CHANGE ENGINE PARTS: Slice a healthy chunk from your auto repair bills by exchanging worn out parts for rebuilts and installing them yourself 1903

PATCHING

HOW TO PATCH PLASTER WALLS: Plastering a whole wall is a job for a professional, but any householder can make repairs, from hairline cracks to fairly large sections 1914

HOW TO REPAIR HOLES IN WALLBOARD: Plasterboard has no lath to provide a backing for the patch, but you can use this trick to provide one 1918

PATIOS

THE BASICS OF PATIO DESIGN: When you remove the furnishings and greenery you are left with some basic shapes. This is where your planning should begin 1919

HOW TO BUILD A PATIO SCREEN: The curved sweep of this patio screen, and the use of planter openings to relieve the repetition of vertical lines, make it attractive to view from either side 1923

PATTERNING, SHOTGUN

CHECKING YOUR SHOTGUN'S PATTERN: Patterning itself will tell you little that you need to know, but it does serve as a check on your shooting habits, and it can reveal a bent barrel 1926

PEST CONTROL

COPING WITH THE INSECT WORLD: Insects have been around for about 200 million years, so you better learn to live with them. Understanding their idiosyncrasies and following these tips should make life outdoors a little less painful 1931

PHOTOGRAPHY

PHOTOGRAPHY FOR BEGINNERS: If you are serious about photography, start right out with an adjustable camera. If you use it according to these fundamentals, you will be taking sparkling, professional-looking pictures in no time **1937**

PHOTOGRAPHY ON THE CAMP TRAIL: If you plan for photography in the same way you do your driving route or supplies, you'll have guaranteed satisfaction in the pictures you take **1949**

PHOTOGRAPHING YOUR FAVORITE TV SCENES: With a litle knowledge and some basic camera equipment, you can film your TV stars right in your own home **1955**

HOW TO PHOTOGRAPH PEOPLE: The way you manage your models is the key to the results you will achieve on film **1959**

HOW TO PHOTOGRAPH INFANTS SUCCESSFULLY: By following some of these helpful hints, you can be the professional photographer in the family and turn out some shots that are truly suitable for framing **1964**

PHOTOMICROGRAPHY

3-D PHOTOGRAPHS THROUGH A MICROSCOPE: Tiny creatures look like science fiction monsters when viewed in stereo on photos you can take using an easily built microscope stage **1972**

TAKE ELECTRONIC FLASH PHOTOS THROUGH A MICROSCOPE: How to make an electronic flash and filter system for your microscope that will enable you to freeze the action of tiny live specimens **1983**

PICNIC TABLE

BUILD THIS PICNIC TABLE: Ideal for families with small children, this outdoor set of furniture can be built easily in hours with just hand tools **1997**

PICTURE FRAMING

HOW TO MAKE YOUR OWN PICTURE FRAMES: You can make frames with specially designed stock or you can make custom shapes and sizes, such as circles and ovals, starting from scratch **1999**

➤ *Plywood sheet paneling was used to convert masonry walled basement into a family room.*

How to Install Wall Paneling

You can use a variety of materials—prefinished plywood sheets, solid boards, enameled panels, or even fiberglass—to replace old walls with new, or build them from scratch in new construction

IN THE ATTRACTIVE ARRAY of solid-wood planking, textured plywood panels and handsome veneers, gleaming sheet plastics, and linoleum-like pliables, there is a product to suit every taste, pocketbook, skill and tool that the home craftsman possesses. If you are in a hurry to make use of a room, prefinished wall coverings are available; but if it's a case of getting the most for cash expended, you can choose from numerous unfinished materials to give masonry basement walls and cracked plaster walls a new look. For new construction, wood paneling eliminates plastering costs.

Solid-wood paneling. This material offers an infinite variety of grain patterns, from the simplicity of plain pine to the elegance of polished hardwoods. In addition, age increases the beauty of natural wood and it is an effective insulator against heat and noise. Besides the interior types of tongue-and-grooved boards, some exterior forms can also be used. Even beveled siding is finding a place on one wall of a room for contrast with plaster or wallpaper on the other walls. Interior planking varies in thickness from ⅜ to ¾-inch; widths vary from 4 to 8 inches; lengths from 3 to 8 feet.

Consider all aspects of a room before ordering material. If you want to subdue a wall, use boards of equal width; accent it by the use of random widths. Three different widths laid in rotation create a feeling of movement, while hit-and-miss increases

panels, gypsum: see wallboard
panels, louvered: see room dividers

it. Random lengths can be laid with all joints aligned, joints of similar widths aligned, or all carefully staggered. It can be applied horizontally, vertically, or in combined directions.

Estimate material needed according to net laying width without deducting for small window openings, and allow 5% for waste.

Solid wood is subject to shrinkage and swelling, even though kiln-dried. If delivered on the job several days before installing, sticker-pile boards with narrow strips separating them. The wood will soon absorb the same moisture content as in the air of the room, with less likelihood of dimension changes after being installed. Swelling might move end boards considerably, buckling them against adjacent walls, so it is better if they are slightly damper than the room, as they will then shrink a trifle after installation. Such moisture conditioning pertains to a room normally heated and ventilated, with the plaster thoroughly dry.

If stickering isn't practical, seal the backs and edges of boards with lacquer or a material such as white *Rez,* also the faces if they are not to be stained or bleached. Sealing can be done before installing, allowing boards to dry, then sealing faces afterward.

For vertical boards over plaster, find a stud by sounding with a hammer, or by drilling small holes 1 inch apart until a stud is located; others will be found 16 or 24 inches apart. When studs are located, strike chalked plumb lines to guide in nailing and fasten 1 x 3-inch wooden furring strips to wall with staggered 8d box nails, one to a stud.

Locate bottom furring strips so that bottom ends of wall paneling will overlap strips. Space the others 1 foot apart on centers, and the top strip about 1 inch from the ceiling. Check top and bottom strips with a straightedge and shim out, if necessary, with pieces of shingle to align strips plumb. Then, using these as guides, span the upper and lower strips with a straight-

Two kinds of paneling, exterior siding around fireplace and vertically grained over counter, define areas in this remodeled family room.

How to Install Wall Paneling 1857

▲ *Paneling like this is available in a variety of textures and colors.*

edge and make the other strips plumb by shimmings. At corners, fill in with vertical furring strips. If the ceiling is to be boarded, do it before covering the walls, and seal the boards before installing. Although it is best to use furring strips over old plaster or ceiling material, wooden panels can be installed directly to joists, shimming boards if necessary.

Some random-length boards, when packaged, are intended to be installed as taken out, the lengths adding up to 8 feet. Try to arrange boards to notch around edges of doors and windows, rather than having a joint at an edge. You can cover inside-corner joints with a molding or fit the boards together, eliminating the molding for better appearance. If the latter, remove any edge rabbet, starting with the full thickness of the board.

If you are right-handed, start at a left corner, face-nailing the starting edge where butting board on other wall will cover the heads, using 3d or 4d finish nails about 6 inches apart. Resulting rigidity causes board to shrink from the tongue edge. If troubled with the boards splitting, drill holes for the nails or clip off the nail points. Nail plain tongue and groove boards at an angle at juncture of tongue and boards. Nail boards with broad rabbets square in, because lapping flange of the next board will cover nailheads. Nail succeeding boards at tongue edge only, joining boards

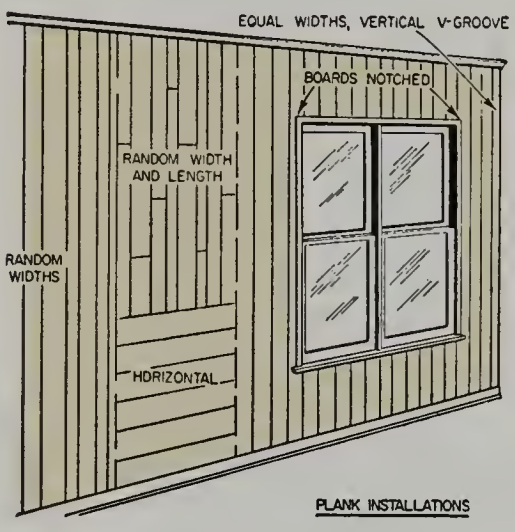
NAILING SCHEDULE

Panel Thickness	Size Nails	Spacing	Lbs. per 1000 sq. ft.
1/4 in.	4d finish or 3/4 in.	6 in. on outer edges of panel; 12 in. on intermediate studs	4
3/8 in.	6d finish	6 in. on outer edges of panel; 12 in. on intermediate studs	7
1/4 in.	3/4 in. No. 19 brad (nailed and glued)	8 in. throughout	3/4

with hand pressure, which allows for slight swelling without buckling. If driving is necessary to draw up a sprung board, use a piece of grooved waste, but discard sprung or warped pieces. Slightly-cupped boards will usually draw flat when nailed at their centers, but extra-short furring strips can be inserted between the regulars where extra nailing is necessary.

Remove covers from wall outlets and switches and fit boards to box size, either by notching the edges or by boring holes and cutting out with a keyhole saw. Advance receptacles flush with board surfaces by replacing holding screws with longer ones, slipping pieces of electrician's loom behind as backing. Cut loom long enough to compress as screws are tightened.

Thickening of walls because of furring and boards raises a problem with the door and window trim. If casings are flat and the same thickness as furring, place the boards over the casings to the edge of the roll. Gauge margin lines on casings and measure from shoulder of last board to this line at top and bottom to get measurements for the lapping board.

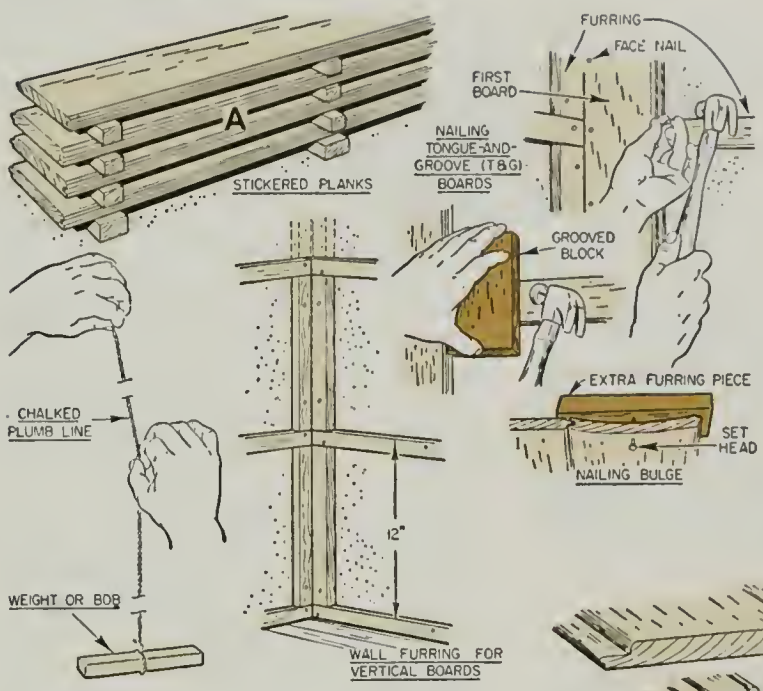


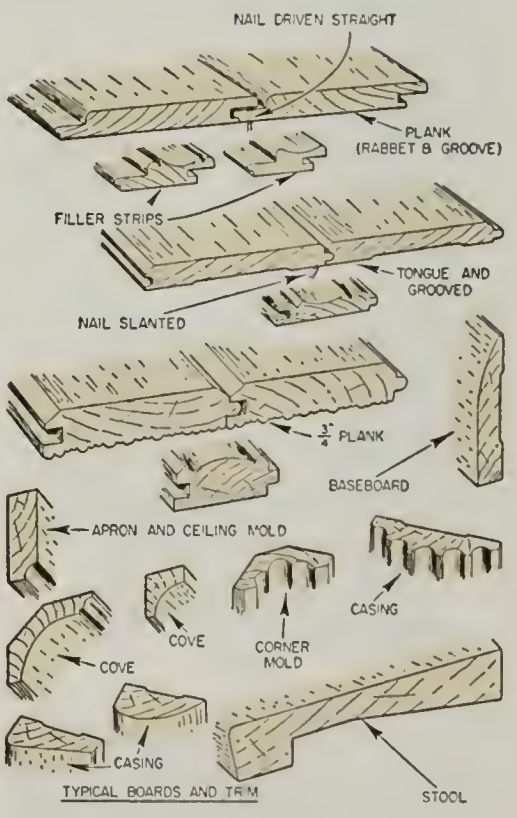
At a door, mark the top of the notch, lay out the width, and rip board. If jamb is crooked, transfer the irregularity to the board with scribers or a compass. Use a smoothing plane to correct edge. Round the edge of the board or sand off the sharp arris and nail in place, face-nailing into casing. Fill in above the door and fit other side, proceeding from there with the wall. If the last board butts against a wall not to be boarded, scribe it to fit, or hide joint with a molding.

Boards around a window having a stool that is not to be removed require fitting at that point also. Tack the piece at the ends and mark the top and bottom cuts for the stool with a straightedge resting on it. Saw the sides of the notch and slip it into place for scribing stool end.

Usually casings and apron must be removed. To salvage moldings, pull nails through from the back with end-cutting nippers, leaving finish and putty intact. Replace old casings with subcasings made from 1 by 2-inch stock rounded on the opening arrises, setting them back from the jamb edges 1/8 to 1/4-inch. Then, carry the boards over these and under stool, eliminating apron.

Stool projection must be increased, for





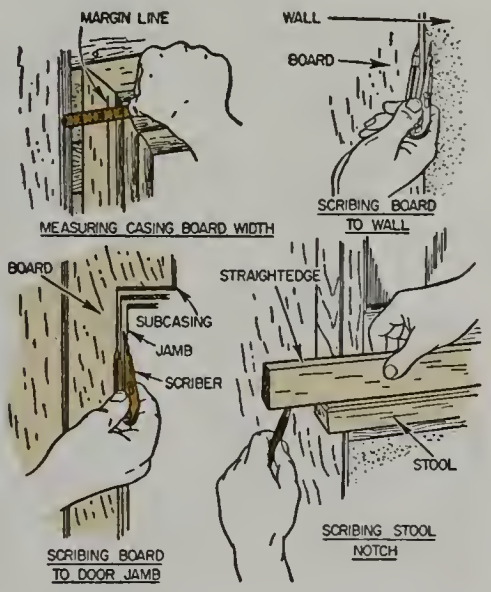
¾-inch board, either by replacing stool or by piecing out the old. To remove, pry off side stops and apron, pull out stool, and nail a strip to the edge of the sill to bring it flush with furring. Install boards below the window, the upper ends flush with sill top. Tack a piece of stool against the jambs by nailing into the board ends and scribe the shoulders by marking along a straight-edge held against jamb faces. Saw the shoulders part-way and split out the waste. Push the stool between the jambs, parallel it with the wall, and scribe the ends to the wall and the inner edge to the sash. Spread scriber legs equal to the projection of stool rabbet outside the boards. When sawing the stool to fit against jambs, jog to fit the setback of the subcasings. Joint sash-edge of stool to give $\frac{1}{16}$-inch clearance for sash, and "return" ends of stool by shaping to contour of front edge, using a piece of stool to scribe profile. The returns project beyond casings equal to the front projection.

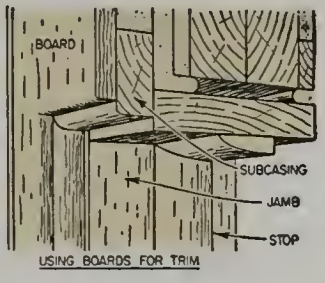
With casements, where the special profile of stool and fitting of sash may make it difficult to replace stool, rip off its projection close to the wall, plane straight, and nail and glue on a wider piece, dropping it $\frac{1}{16}$-

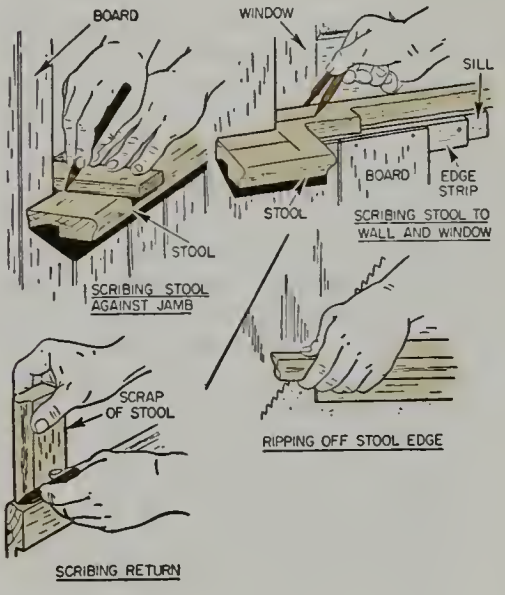
inch for an offset which hides joint. To attach casings, install subcasings equal to furring plus board thickness, bringing jamb flush with wall surface; then, apply casings as in new work. Door casings can be purchased in sets of two 7-foot lengths and one 3-foot header. To case a door, scribe side casings to fit floor, stand them in place and mark locations of the mitered corners. Check with a straightedge to determine whether wall boards project to recede from subcasings, and reproduce the condition in the miter box by placing a suitable shim under the rear edge in the first case, or under the front edge in the second case when mitering. Do the same with the head casing. If the opening isn't square, block casing out from the miter box side to the same angle it will occupy when placed, besides shimming for wall misalignment. Nail left casing first, nailing in the back edge before front. Next, hold head casing in place to mark the right end for length and, when fitting the miter, use a block plane for corrections. Fit right casing, and nail.

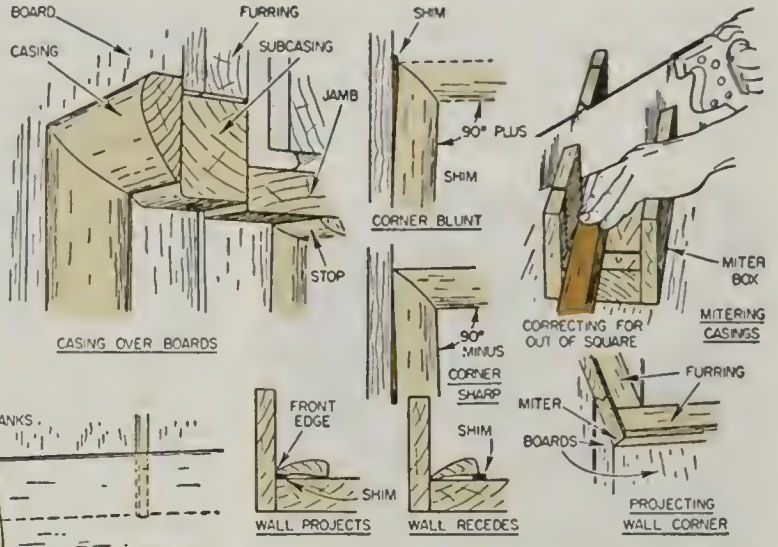
When window casings are mitered all around the opening, begin at the lower left miter and work around. Tack pieces as you go, so that you can remove them for further fitting if necessary. Projecting wall corners are best mitered, nailed and glued, although they can be butt-jointed and a corner mold used.

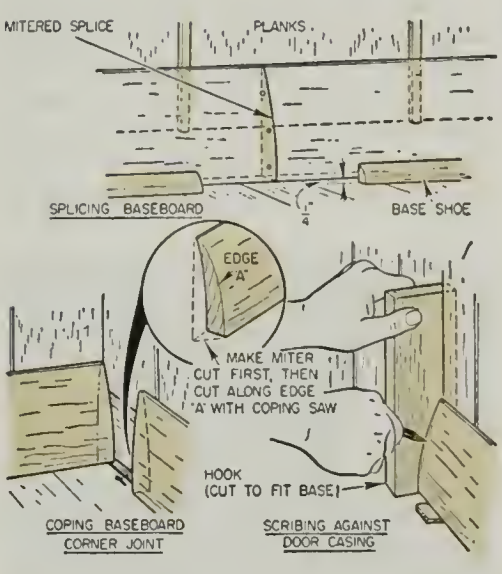
Before installing baseboard, nail strips along wall beneath board ends to support lower edges of baseboard which is shimmed up ¼-inch above the hardwood floor. Working from left to right, cut a piece of baseboard to extend full length of wall, if possible. To piece it, miter the joint with the lap in the direction of most usual viewing. Next, cut a 45° miter on end of other baseboard butting against it, then saw along edge to contour to form coped end to fit snugly against first baseboard. If there is a

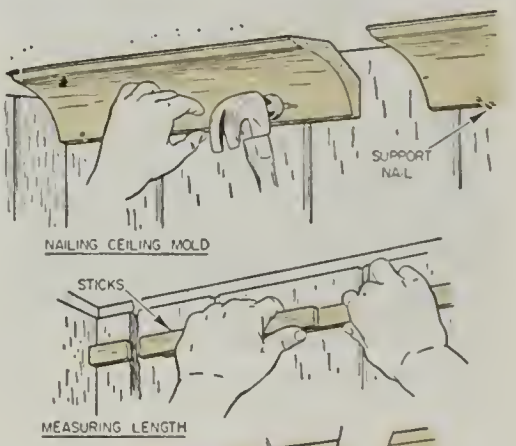


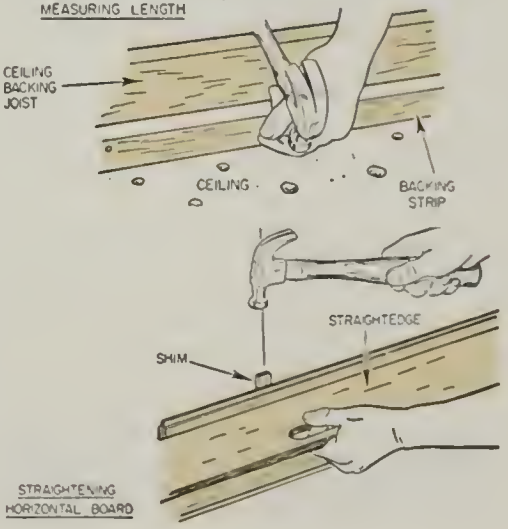












door, scribe along casing with a hook held against it. While baseboards can be fitted tightly, avoid such pressure that the casing and jamb are forced inward, causing the door to bind. If the fourth wall has no opening, cope both ends of the fourth baseboard against those in place, making it $\frac{1}{32}$-inch longer, and spring in place. If the fourth baseboard must be spliced, cope and back-miter one piece and nail it down. Then cope corner joint on other piece, mark and cut splice and spring into place, nailing splice.

Choose ceiling moldings of a design that will be in harmony with baseboard and trim. If wall boards have simple V-joints,

use a small, plain cove or almost flat molding wide enough to cover gap. If boards have wide decorative joints use large 2 to 4-inch moldings. Measure lengths of molding with a couple of over-lapping sticks gripped tightly at the lap and, lacking somebody to help with a long piece, drive a nail a little below location of lower edge to rest molding on. Nail small molds along the bottom only; larger, sprung molds may require nailing into the ceiling also, which can be done at ceiling joists. For molding parallel to joist direction, angle and drive long finish nails into the backing joist. In a single-story house, climb into the garret and nail 2 x 2-inch backing strips along the backing joist.

A base shoe at the floor is the finishing touch for walls, narrow ⅜ by ¾-inch quarter-round being best if practical. It can be substituted for baseboard where boards come close enough to the floor. With hardwood-block flooring ¾-inch or 1-inch quarter-round is recommended. Over block

When applying wood paneling, measure and mark the position and size of doorways, using a china marking grease pencil or any other marker that will wipe off clean.

Use a crosscut saw with panel face up so the saw cuts into the face on the down stroke. If you are using a portable power saw, mark the panel on the back and cut it face down.

flooring on a concrete base, shim up base shoe molding $\frac{1}{16}$-inch to permit block movement.

Wall boards placed horizontally can be nailed through plaster studs, shimming if necessary. However, furring over studs is better. When covering masonry walls, use furring. (CAUTION: First make sure walls are dry, or have been waterproofed against seepage.) If wall boards are to be used as wainscoting below vertical boards, make the juncture below or above the height center of the wall. For flush effects groove the vertical board ends to fit over the horizontal tongue, or use a filler strip between.

Plywood walls and ceilings. With their many varieties of veneers and textures, plywood wall panels and ceiling squares have the advantages of being non-splitting, resistant to warping, and easy to install with a minimum of labor and time. Plywood also has fair insulating and sound-absorbing qualities and imparts structural stiffness when properly installed.

▲ *Beads of panel adhesive are applied quickly and easily with a caulking gun.*

◀ *To cut out holes for electrical fixtures and the like, drill pilot holes at the corners and finish cut with saber or keyhole saw. Be sure to bring fixtures out flush with panel surface.*

The simplest and most economical method of installing plywood panels is to start at a corner of the room where a full panel can be used and to continue with full sheets to the end of the room. With normal 16-inch stud spacing, joints fall on every third stud. One or more panels will usually have to be cut narrow, and window and door openings make well-proportioned joint spacing a problem. One solution is to subdue joints by finishing the wood to reduce grain contrast. Striated-plywood joints are lost, because they resemble the surface grooves.

▲ *Half nail the panel at the top to provide a hinge action.*

➤ *With the panel nailed at the top, swing the bottom out from the wall and prop it in that position for 8 to 10 minutes with a wood block. This allows some of the solvent in the adhesive to evaporate so the adhesive will set faster.*

Plain panels trimmed to join on window and door studs, recessed joints and a continuous wainscot covering lower part of the wall is another treatment. The flush butt joint under center of window is made by gluing a 4-inch wide plywood plate to back of two panels of closely matching grain before installing.

For a random-board effect, use 16-inch interval factory-grooved sheets, having extra grooves added. Or you can cut the grooves yourself in plain panels to simulate random-width, solid-wood paneling. Attaching nails can then be driven through these grooves into the studs. Cut vee-grooves with a power router, or with a

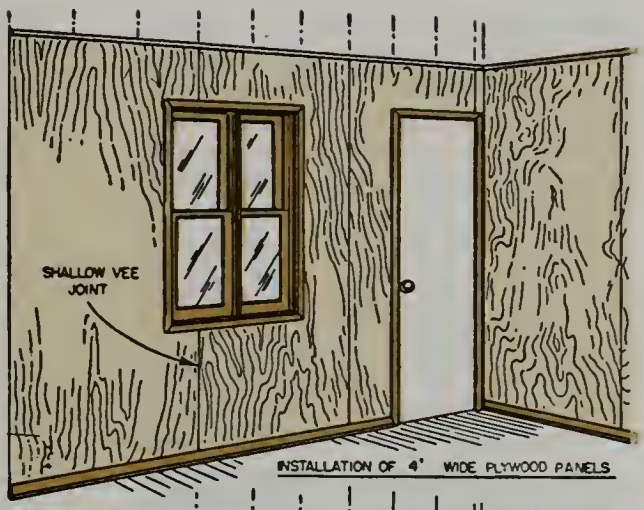
portable power saw tilted 45°. Smooth sawed grooves with sandpaper backed with a sharp-edged block. A jig built of scrap wood to cradle a power drill clamped at an angle to hold a ball-cutter at the best angle for making rounded grooves is still another method.

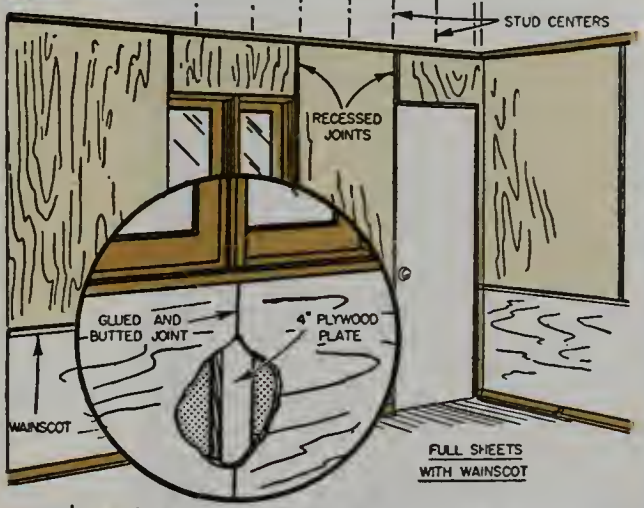
If you are building a new home and plan to have a plywood ceiling, ceiling joists can be placed with one at the center of room or spaced apart at the center. The other ceiling joists are then spaced regularly toward the ends of room for best use of the plywood panels. Old ceilings often present the bugbear of uneven spacing. One way of overcoming this is to nail furring

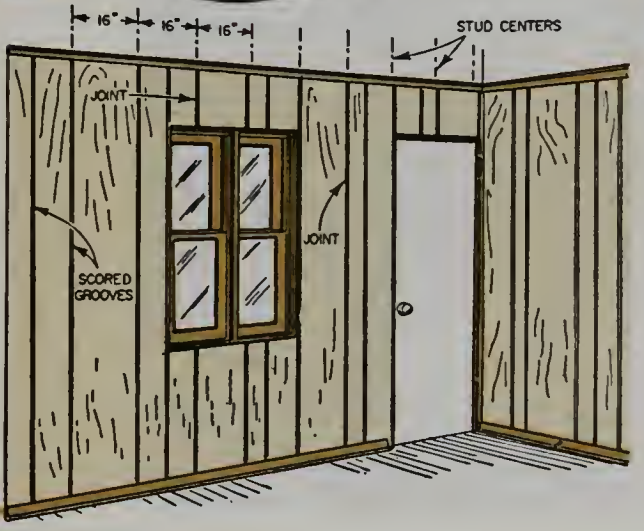
▲ *Press the panel firmly in place and tap it gently. Use a cloth wrapped block of wood to protect the panel finish.*

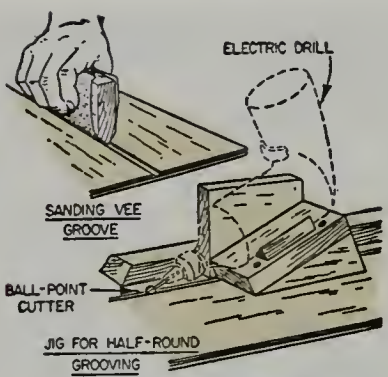
➤ *The completed room with prefinished paneling installed.*

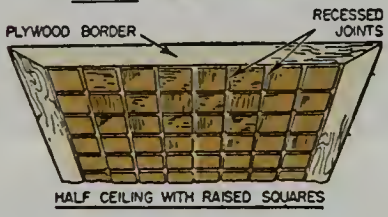
1866 *How to Install Wall Paneling*

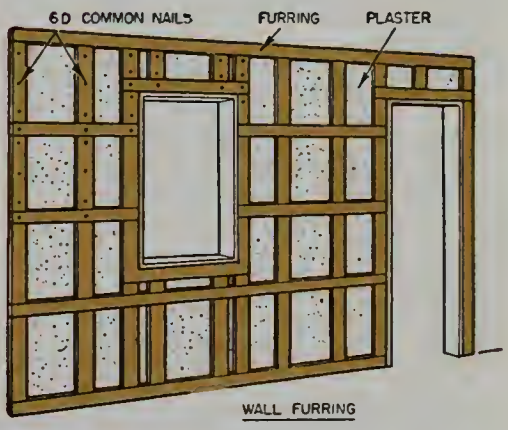












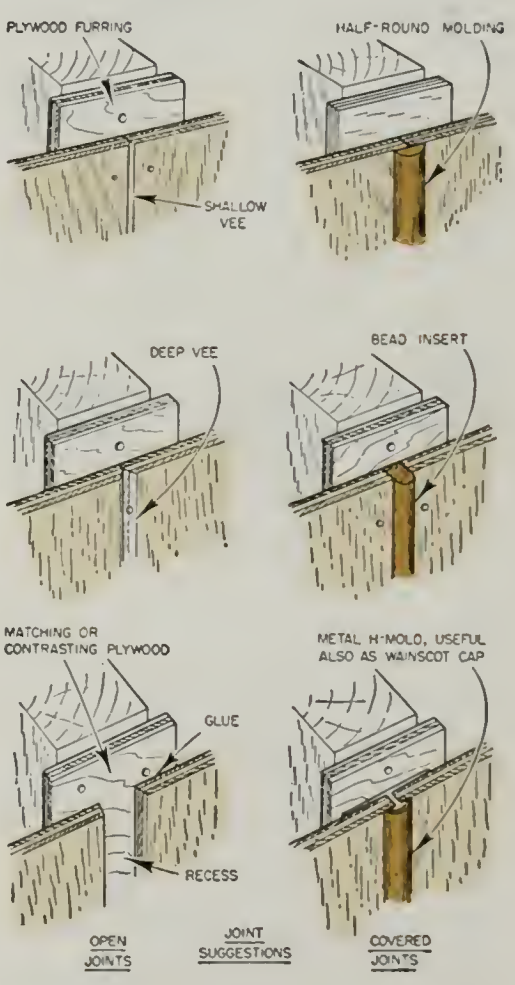
strips at right angles to the ceiling joists and space them as for new construction. Then fasten the plywood panels to the furring strips. Better is the random board plan, or the use of striated sheets or squares. An underlayment of $\frac{5}{16}$-inch sheathing-grade plywood permits nailing anywhere and allows application of symmetrical patterns. A popular arrangement is squares butted, with deep vees, or with recessed joints, using stock sizes of 12, 16, or 24-inch, or other sizes cut from standard sheets. Since most rooms are not evenly spaced in both

When you do not have someone to help you, panels can be installed with the use of "props," as shown.

directions, draw the plywood squares to scale on paper and determine by trial and error what size square fits best. Avoid cutting squares by running a border around the edge, perhaps with end margins wider than side margin. Rectangular dimensions can be calculated to come out even in both directions by using channeled or recessed joints, widening them if need be, along the length of the room. Install ceiling before walls.

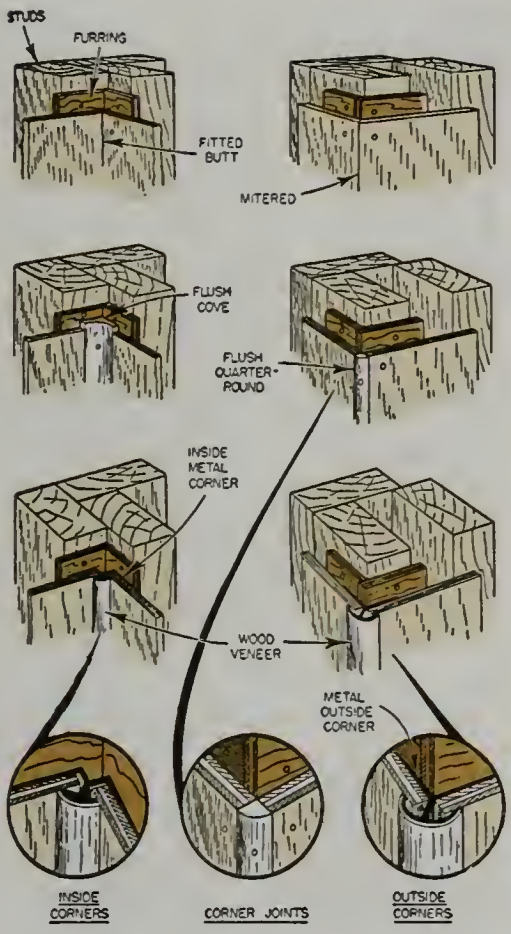
Preparation for remodeling. Most casings around doors and windows can be left on if they harmonize, but it is usually best to remove backbands. Scrape and sand off any paint lumps or ridges. If you want matching trim, remove the old, and remove picture molds and baseboards. If increasing depth of jambs is necessary, follow procedure for solid-board paneling.

Old plaster is usually reasonably flat, a good base for overlaying plywood. Some manufacturers recommend 1 by 4-inch furring spaced horizontally 16 inches apart, but the general practice is to saw 2 or 2½-inch wide strips from ¼-inch plywood, nailing them to studs with a horizontal spacing of about 16 inches, one nail per stud, centered. Nail short pieces over studs that back-up the joints and, for added stiffness for sheets, nail strips over other studs, and around openings, shimming out dips in the furring. Sheathing underlayment, if used, must be applied so that its joints and those of the facing are staggered.



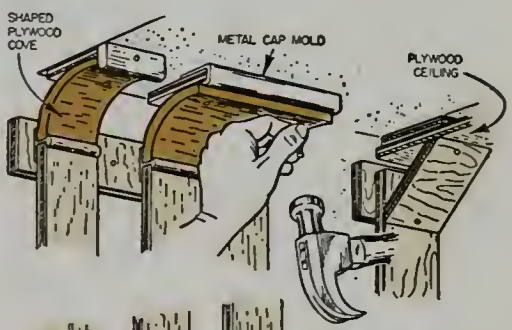
It can be laid flat over a bulgy wall by nailing shims in the low spots, aligning their faces with a straightedge.

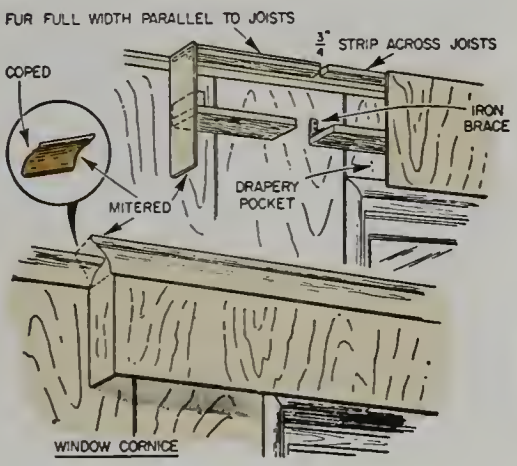
Preparation for new work. Probably

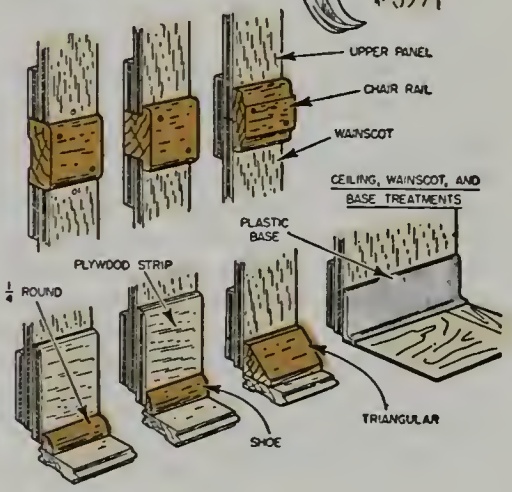


most plywood wall coverings are nailed directly to studs, and blocking, sometimes with disappointing results because of stud irregularities. If you use this method, frame with straight, No. 1-grade studding. Nail header blocks between studs for every 4 feet of sheet length, and wherever joints occur. These will also serve as fire stops. For ceiling application, install header blocks. When ⅜-inch plywood is used, studs can be spaced 24 inches. Apply furring strips to studs and along headers, making window and door jambs of a width to come flush with plywood panels, as with plaster.

Install plywood only over waterproofed masonry walls and on furring strips. Where masonry nails fail to penetrate properly, make ½-inch holes with a masonry drill and drive in wood nailing plugs. Often it is easier to build a frame of 2 x 3-inch studs and plates, anchoring it to the masonry,





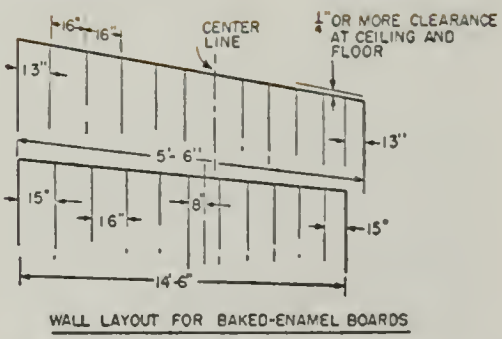


providing space for wiring and shallow built-in cabinets, if desired.

Installing panels—remodeling. Select panels and arrange them to concentrate flashy grain at the center of the wall or at the ends, with strong grain direction upward in vertical panels. Coat backs of sheets for outside walls with resin sealer or priming paint. The usual practice is to only nail on plywood sheets, but a much better job is done if they are also glued with urea or casein glue. The first is waterproof under normal conditions, the other water-resistant. Mix according to directions and paint a thick stripe along middle of furring strips and nail. Both glues require working temperatures of 65°—higher temperatures hasten setting. A portable high-frequency electrical unit that sets urea glue almost instantly is available that literally spotwelds the panel to furring strips (eliminating use of nails), the glue between tacking points hardening normally.

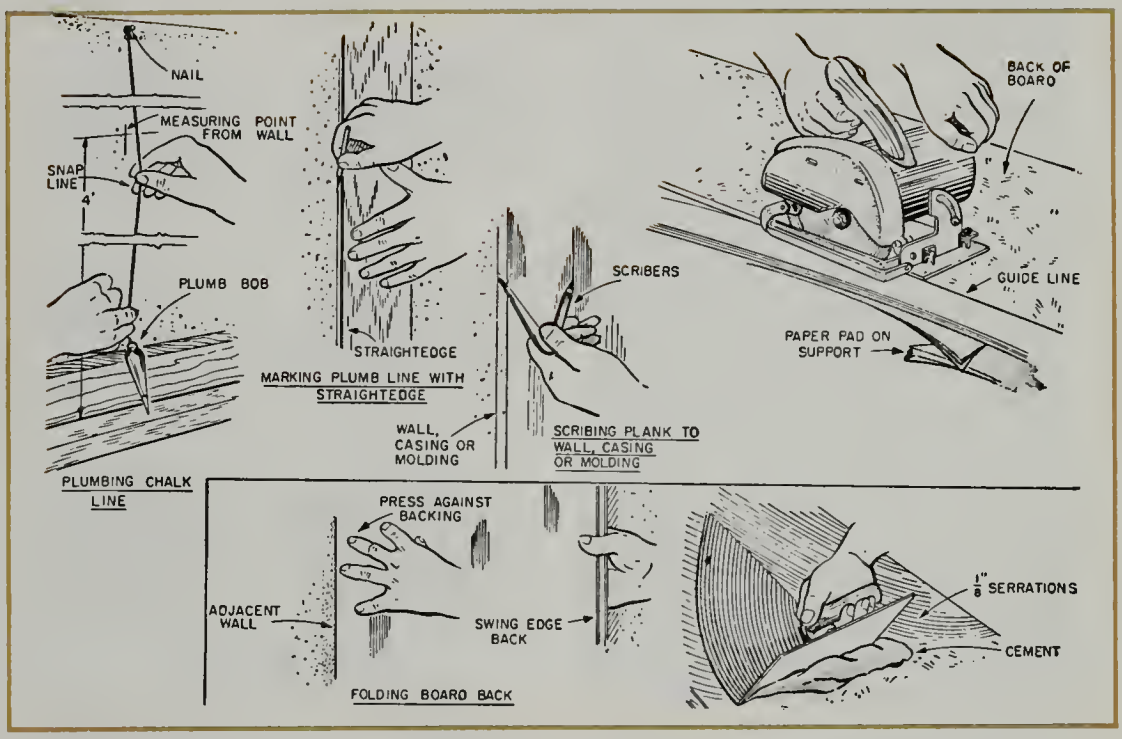
Cut the starting edge of the first panel to fit in the corner with the other edge plumb and over a stud, apply glue, and tack in place. Then nail, working from the center out. Face nail at grain angles or in bottoms of serrations and the like, or drive them in one side of a vee-groove. The next panel is butted, or spaced by inserting a gauging strip in the joint for nailing. Lacking help, wall or ceiling panels are easily installed using a pole with a cross piece at the top, like the letter T. Over masonry walls, install bottom edges of panels about 1 inch above the floor to promote ventilation behind.

Open joints can be made several ways. The arrises are lightly chamfered with sandpaper to prevent splintering. Or, the edges can be butted and accented with a deep vee joint. With a third method, the recess in the open joint is backed by a plywood furring strip of the same or contrasting color for increased accent. Furring is nailed to studs and glue applied at the edges for plywood panels.



WALL LAYOUT FOR BAKED-ENAMEL BOARDS

In a simple covered joint, the edges are butted and covered with a molding, generally matching the color of panel. Or, a strip with a projecting bead is inserted in the joint by blind-nailing it against previous panels. In a third kind of covered joint, stock extruded aluminum molding of H-section is used. Bead is faced with matching veneer. Slip it over a loose edge, nail through web, and insert next panel edge. Where metal molds are used throughout, it may be necessary to face-nail through plywood and molding web on last piece.



Make an inside corner by scribing one panel to fit neatly against the panel on the other wall, or install a vertical strip of cove molding on the corner and butt each panel flush to it. A third method is to install a metal corner molding and insert the inside edge of each panel into its grooves. A metal outside corner molding is also available. Outside corners can also be made by installing a quarter-round molding on the corner and butting the panels flush to it, or by mitering the panels at the corner.

Plywood panels seldom reach the ceiling, the gap being covered with moldings as for solid-wood paneling, or shaped or flat plywood coves can be used. If you prefer, a wainscot, wainscot cap or chair rail can be inserted between panels, or rabbeted at the edges to lap them.

Several baseboard treatments are possible. A solid wood baseboard is best if it matches color of wall covering. If a hardwood block floor is present, raise the baseboard and shoe to allow for movement of the blocks. Plastic base cove is good with tile floors.

Plywood is ideal for cornice boxes. Miter the corners and support by a ¾-inch thick shelf fastened to wall with angle brackets. Make cornice pocket large enough to contain traverse rod and drapery.

When applying squares to walls or ceilings, tack on a straightedge at the center to butt a starting row. For diagonal treatment, nail a straightedge at a 45° angle at a strategic point on the sheathing underlay and tack a second at right angles to the lower end. Fill in the vee, remove straightedges and complete installation.

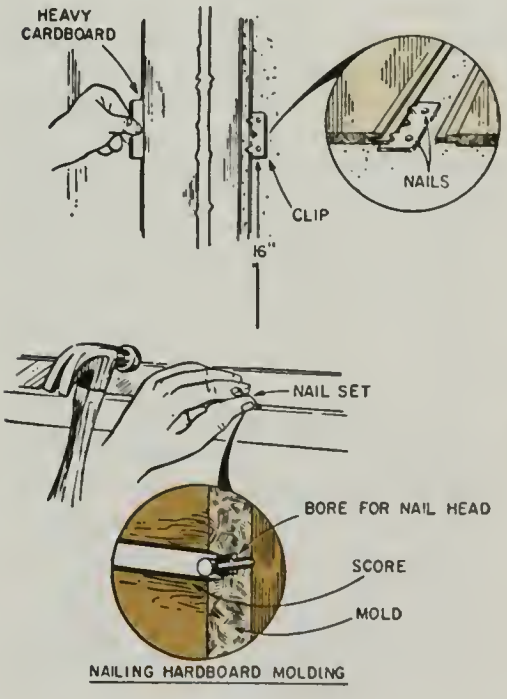
Finished hardboards and fiberglass panels. Hardboards—fabricated sheets that are tough, grainless, non-checking and splitting—are ideal for color finishes. Enamel surfaced types are available in solid bright and pastel colors and in a wide variety of patterns, some simulating pol-

ished hardwoods and veined marble. In addition, boards and tiles are made for bathrooms and other service areas, with matching hardboard moldings, metal moldings, plain and finished like the boards. Stock wooden molds are also applicable.

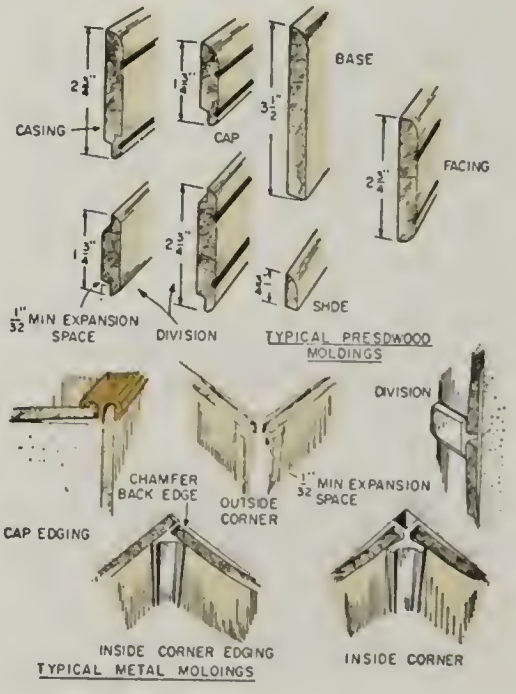
Boards, tiles and squares are ideal for use when remodeling, being light, easily-handled units with tongue and groove edges secured to walls with clips, or clips and adhesives.

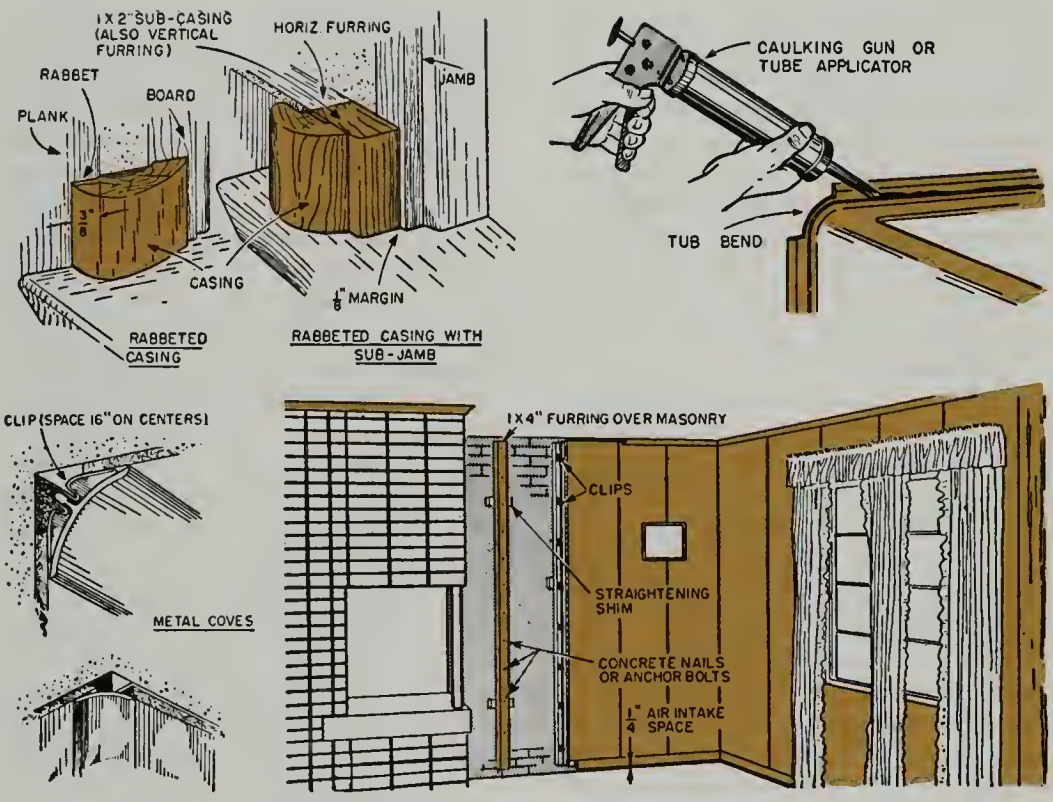
These materials come in cartons and, if the weather is rainy or otherwise excessively humid, thoroughly dampen the backs and stack them, back to back on a flat surface, to season for 24 hours. If uncertain as to the need for such conditioning, consult your local dealer. As a precaution against abrasion, lay sheets of newspaper between the finished faces.

Most dry, old plaster, or plasterboard walls that are flat, are suitable backing for boards, tiles or squares. Scrape off all loose paint, paper, or plaster, and repair large depressions or holes and remove baseboards, window and door cap molds, backbands, and picture molds. Disregard stud spacing, locate wall center and lay off board widths from right and left so end units are of equal width. Start board installation at one corner of room by plumbing a mark on wall where groove-edge falls, using a chalked plumb line or running a pencil along a straightedge. If you use a corner mold, measure distance from wall to line at floor and ceiling, transfer measurements to first board, and mark a guide line with a straightedge. If no mold is used, stand board on a block of suitable thickness with grooved edge of board toward area to be covered, plumb it, and tack with a nail at top and bottom. Spread dividers or scribers to the width of strip to be cut off and mark. To hand saw, support board (face up) on solid backing, using a fine-tooth saw. With an electric saw, turn face down, protecting it with a pad of papers laid on support. Special cement as well as attaching clips are



NAILING HARDBOARD MOLDING





recommended and, if there is any doubt about the holding power of the wall, cement is mandatory. Spread a thin coat of approved adhesive with a serrated trowel to back of board and to wall. Set board in place with trimmed edge contacting adjoining wall, and fold board against its backing. Snap on clips near top, bottom, at the center and two evenly spaced between; or space about 16 inches on centers. Cutouts must be made for wall switches and receptacles. Drive nails supplied, or use common lath nails driven with light blows to get maximum holding power. Don't force edges of boards together; allow about $\frac{1}{32}$-inch space, gauging with a piece of heavy cardboard to provide for expansion. Continue installing boards until the last one, which is fitted to the next wall (unless the boards are continued around), only cementing last board. If boards are slightly shorter than room height cover with moldings at top and bottom.

Scribe the boards around openings, against complete casings, or roughly against casings where backbands will cover joints. At door and window heads, where cap molds are to be added, fit can be rough. Remove apron under a window stool and fit boards under stool, or cover joint with a mold, if you prefer boards to fit under apron.

Install boards over plaster in new work as over old walls, or fur bare studs horizontally with 1 by 4-inch strips spaced 16-inch on centers, wedged plumb, if necessary. Fill in with vertical strips at corners and openings. When the ceiling of a room is to be covered with squares, install them first.

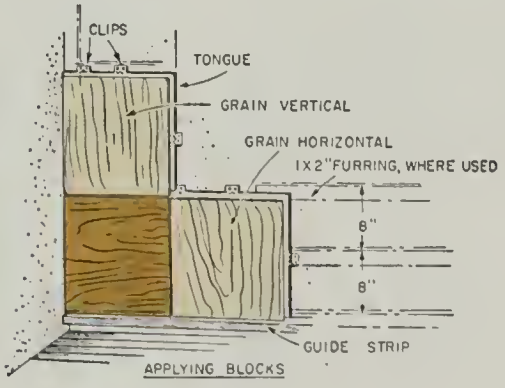
When applying single-member casings over a resurfaced wall, rabbet backs to a depth of wall-covering thickness, or use

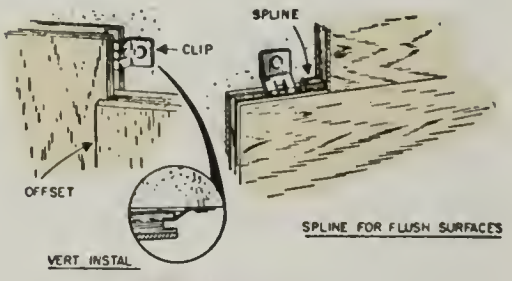
rabbeted hardboard molding. If furring has been used, build out jambs with sub-casings, which also function as vertical furring. Set them back ⅛-inch from the jamb faces to avoid a flush joint. On new construction, make the jamb widths sufficient to bring edges flush with wall-covering surface. When working toward a window opening over plaster, notch board over stool end.

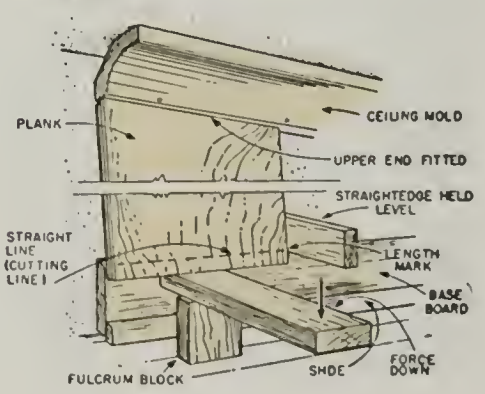
If you prefer hardboard moldings, install like wood moldings, with finish nails driven into the grooves, if present. Drill holes slightly larger than nail heads half-way through molding and set heads. Metal moldings are usually nailed in place and the board edges slid into them, with a space of at least 1/32-inch for expansion. Around bathtubs and showers set metal moldings in corners, using at the front of a tub bends that carry a continuous band along the top and down the front. On all such installations fill moldings and grooves with mastic designed for the purpose. Remove surplus mastic before it dries. Fur masonry walls vertically to allow circulation of air, and place baseboard 1¼-inch above floor to admit air.

Squares are usually 16 inches, installed, basically, the same as boards. After determining width of starting space, strike a guide line for the forward or grooved edges of the squares, and take measurements from it to the wall for scribing squares to the wall. Like boards, gauge joints with cardboard to insure at least 1/32-inch expansion space. Check irregular spacing to prevent "running," or squares climbing in places. Begin installing at a bottom corner with a square fitted to the near wall and one tongue-edge down, the other having been trimmed if it is to fit against wall. Guide the first row by resting squares on a strip of wood tacked level at the bottom. On new work place furring strips over studs at 8-inch centers.

Boards are available as thin, prefinished hardwood plywoods. While they can be installed in several ways, as over studs spaced to fit, furring, or an underlay of 4 by 8-foot, 5/16-inch plyscord sheets, the usual manner is similar to baked-enamel boards, but without cementing. One popular brand is grooved on both edges and engaged with the back flange of one edge inserted in the groove of the previous panel. Clips are secured with cement-coated or screw nails, or with 3- or 4-penny lath nails. Tap joints together with a hammer and block, to avoid damaging edges. If end-







HOW TO SELECT WALL COVERINGS

Kind	Size and Thickness	How to Apply	Recommended Uses	Advantages	Disadvantages
SOLID-BOARD TONGUE-AND-GROOVE PANELS	3/8-3/4 in. thick, 4, 6, 8 in. wide; 3-18 ft. long	Nail or staple to furring. In new construction sometimes laid on studs and blocking. Back and edge sealing recommended	Walls in dry locations; old or new construction	Available in many woods. Durable. Medium to high cost. Fairly easy to maintain. Easy to cut and apply. Does not dull tools. Light weight. Has insulating value	Shrinks and swells. May check. Trim must be removed. Not fireproof
EXTERIOR SIDING	3/8-3/4 in. thick, widths to 11 1/2 in., lengths to 20 ft.	Nail to furring. In new construction sometimes laid on studs and blocking. Back and edge sealing recommended	Walls in dry locations; old or new construction	Available in soft woods, some hard. Durable. Medium to high cost. Fairly easy to maintain. Easy to cut and apply. Does not dull tools. Light weight. Has insulating value	Shrinks and swells. May check. Trim must be removed. Not fireproof
PLYWOOD PANELS	1/4, 3/8, 5/8, 3/4 in. thick. Heavier sheets for structural panels. 48 by 96-120 in.	Nail or nail and glue to new construction. Fur over old walls. Back and edge sealing recommended. Waterproof masonry	Walls in dry locations; old or new construction. Common fir plywoods for inexpensive construction, hardwoods for fine work	Available in many woods. Durable and rigid. Fairly easy to maintain. Medium easy to cut and apply. Does not dull tools. Light weight in thin sheets. Spectacular paint effects possible on textured patterns; handsome hardwood finishes. Some insulating value. Will not split, shrink, or swell	Grain rises after finish with fir panels. Not fireproof. Trim removed. Textured types catch dust
PLYWOOD BOARDS	1/4 in. thick, 16 in. wide, 36-96 in. long	Clipped to old walls or to furring, old or new construction. Can be nailed. Back and edge sealed	Walls in dry locations; old or new construction. Common fir plywoods for inexpensive construction, hardwoods for fine work	Light and easy to handle. Plywood qualities	Not fireproof. Trim removed
PLYWOOD SQUARES	1/4 in. thick, 12-16 in. square	Clipped to old walls or to furring, old or new construction. Can be nailed. Back and edge sealed	Walls in dry locations; old or new construction. Common fir plywoods for inexpensive construction, hardwoods for fine work	Light and easy to handle. Plywood qualities. Can be applied parquet-style	Not fireproof. Trim removed
VENEERS, SHEETS	12-24 in. wide, 8, 10, 12 ft. long	Cemented to any solid backing. Waterproof walls	Where rich seamless hardwood facing is desired. Curved walls	Variable to matched-hardwood grain effects. Reasonably durable. Flexible, applied like wallpaper. Not necessary to remove trim. Fairly easy to maintain	No structural strength. Requires rigid, nonshrinking backing

Kind	Size and Thickness	How to Apply	Recommended Uses	Advantages	Disadvantages
VENEERS, WOVEN	1/16 in. thick, 48 in. wide, 96 in. long	Cemented to any solid backing. Waterproof walls	in room where parquet effects are desired	Available in fine hardwoods, diamond and parquet patterns. Variable to matched-hardwood grain effects. Reasonably durable. Flexible, applied like wallpaper. Not necessary to remove trim. Fairly easy to maintain	No structural strength. Requires rigid, non-shrinking backing
HARDBOARD, SHEETS	1/8, 3/4, 1/4 in. thick. Heavier sheets 1/2-1/4 in. thick rarely stocked for structural panels. 36, 48 in. wide, 96-120 in. long. Cut sizes available	Cement thin sheets to plastered walls, nail to new stud and block construction, or to furring over masonry	Service rooms, rumpus and game rooms, bathrooms	Good paint base, takes strain, natural finishes in light wood to brown colors. Durable, hard surface resistent to scuffs and dents, easily maintained, easy to cut, covers rapidly, warp and shrink resistant	No grain character in smooth panels
HARDBOARD, CHIP CORE	3/8, 3/4 in. thick, 24-72 in. wide, 72-144 in. long, heavier sheets for thin walls, etc.—rarely stocked. Cut sizes available	Cement thin sheets to plastered walls, nail to new stud and block construction, or to furring over masonry	Service rooms, rumpus and game rooms, bathrooms. Also better rooms	Attractive flaked figure suitable for stain, natural finishes. Durable, hard surface in pine or redwood, resistant to scuffs, easily maintained, easy to cut. Warp and shrink resistant	Molding shows porous core
HARDBOARD, PERFORATED	1/8, 3/16, 1/4 in. thick, 24, 36, 48 in. wide, 36, 48, 72, 96 in. long. Cut sizes available	Cement thin sheets to plastered walls, nail to new stud and block construction, or to furring over masonry; also in frames	Modernistic effects, game and service rooms, etc.	Punched with holes to take wire brackets for hanging items; available in some prefinishes; also embossed to imitate leather; hard resistant surface, easily maintained, easy to cut. Warp and shrink resistant	Dust catching
INSULATION BOARD, SHEETS	1/2 in. thick, 48 in. wide, 72, 84, 96, 108, 120, 144 in. long	Nailed preferably over furring. Battens generally used	Most rooms for inexpensive construction	Prefinished white or cream, smooth or textured surface, square or beveled edges. Can be painted. Easy to cut, light weight. Good insulation	Easily scuffed and punctured
INSULATION BOARD, BOARDS	1/2 in. thick, 8, 12, 16 in. wide, 96, 120, 144 in. long	Nailed or stapled, preferably over furring	Most rooms for inexpensive construction	T & G, prefinished in a variety of colors. Can be painted. Low-cost. Easy to cut, light to handle. Universally obtainable. Good insulation	Easily scuffed and punctured

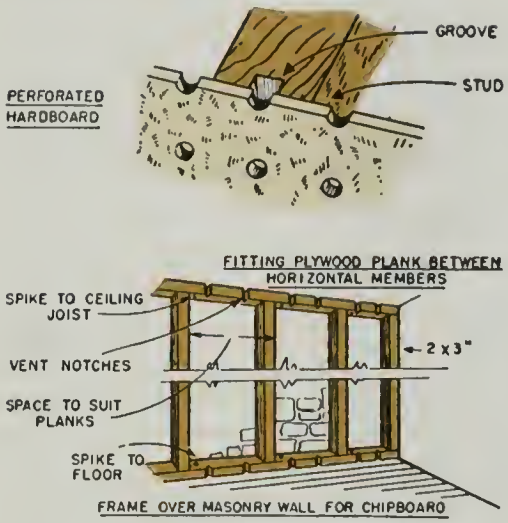
HOW TO SELECT WALL COVERINGS

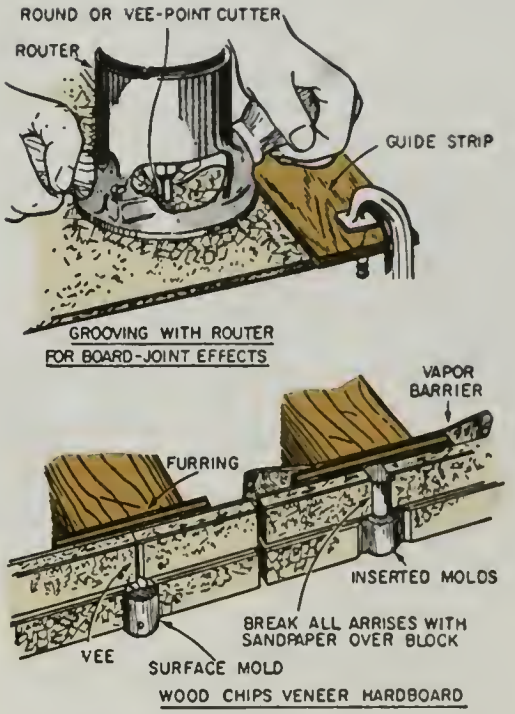
Kind	Size and Thickness	How to Apply	Recommended Uses	Advantages	Disadvantages
PLASTIC SHEETS	1/16, 1/10 in. thick, 24-48 in. wide, 96 in. long	Cemented to old walls or backing in new construction. Metal molds or hardboard	Especially for service rooms, bath, wainscots	Many rich, glossy colors and patterns. Very durable. Resistant to ordinary solvents, stains. Easily cleaned with damp cloth and mild soap. Almost abrasion and puncture-proof. Can be slipped under edges of trim	Brittle until mounted. Hard to cut. Dulls tools
PLASTIC SKINS	18 to 54 in. wide in rolls	Cemented to smooth old walls or backing	Especially for service rooms, bath, wainscots	Many rich, glossy colors and patterns. Very durable. Resistant to ordinary solvents, stains. Easily cleaned with damp cloth and mild soap. Almost abrasion and puncture-proof. Can be slipped under edges of trim. Inexpensive plastic	Tends to shrink
FIBERGLASS REINFORCED SHEETS CORRUGATED	1/16, 1/10 in. thick, 14, 26, 27 1/2, 33, 33 3/4, 35, 36, 40, 42 in. wide; 36, 48, 60, 72, 84, 96, 120, 144, 166 in. long. Corrugations, crown to crown (pitch) 1 1/4 to 4 1/2 in.	Hold in frames with wood or metal closures	Walls and screens to admit and control light	Many translucent and opaque colors. Very durable, waterproof, resistant to ordinary solvents, stains. Easily cleaned. Almost abrasion and puncture-proof. Rigid	Dulls tools. Expensive
FIBERGLASS, FLAT, RIBBED	1/20, 1/16, 1/10 in. thick, 16, 24, 30, 32, 36 in. wide, 48, 60, 72, 96, 120, 144 in. long	Hold in frames with wood or metal closures	Walls and screens to admit and control light	Many translucent and opaque colors. Very durable, waterproof, resistant to ordinary solvents, stains. Easily cleaned. Almost abrasion and puncture-proof. Rigid	Dulls tools. Expensive
PLASTIC TILE	4 1/4, 8 1/2, 10 in. square	Cemented to backing	Wainscots, showers, bathrooms, kitchens	Rich, sparkling colors; fairly easily fitted. Durable. Abrasive and puncture resistant. Waterproof. Easily cleaned. Resistant to dirt, ordinary solvents, stains	Can be scratched and broken

Kind	Size and Thickness	How to Apply	Recommended Uses	Advantages	Disadvantages
INSULATION TILES	1/2 in. thick, 12, 16 in. square, 12 by 24 in., 16 by 32 in.	Nailed or stapled, preferably over furring	Especially for ceilings. Acoustic (semi-perforated) to control room noise	T & G, prefinished in a variety of colors. Can be painted. Low-cost. Easy to cut, light to handle. Universally obtainable. Good insulation. Square and rectangular tiles can be mixed and laid in a variety of patterns	Easily scuffed and punctured
GYPSUM BOARD	3/8, 1/2, 5/8 in. thick, 48 in. wide, 96-144 in. long	Nailed over studs and blocking, or over furring. Joints taped and puttied or covered with battens. Second ply crossing first, cemented, with or without nails	All walls	Good substitute for plaster. Dry wall construction. Applied single or double ply. Inexpensive. Rapid application. Fireproof	Rather easily scuffed. If two-ply, laborious. Poor insulation
GYPSUM BOARD, WOOD-GRAINED	3/8 in. thick, 48 in. wide, 96 in. long	Nailed over underlay or smooth plaster	Rooms for inexpensive woodgrain decoration	Three wood finishes available. Applied with or without battens. Cleaned with damp cloth or mild soap	Rather easily scuffed
PLASTIC, OR ENAMEL SKINS ON HARDBOARD	1/8, 5/32 in. thick, 48 in. wide, 60, 72, 96, 144 in. long	Cemented over smooth walls or new construction with plywood or hardboard backing. Usually metal trim, plastic base cove. Also prefinished hardboard trim	Especially for service rooms, bath, wainscots	Many rich, glossy colors. Tile and board patterns. Resistant to shocks, dirt, staining. Bends to large curves. Can be fitted against trim	Rather hard to cut. Dulls tools
PLASTIC SKIN ON HARDBOARD, BOARDS	3/16 in. thick, 16 in. wide, 96 in. long. Smaller sizes available	Cemented over smooth walls and held with clips. New construction, furring and clips if not backed. Metal or hardboard trim	Especially for service rooms, bath, wainscots	Many rich, glossy colors. Tile and board patterns. Resistant to shocks, dirt, staining. Bends to large curves. Can be fitted against trim. Easy to handle	Rather hard to cut. Dulls tools
PLASTIC SKIN ON HARDBOARD, SQUARES	3/16 in. thick, 16 in. square	Cemented over smooth walls and held with clips. New construction, furring and clips if not backed. Metal or hardboard trim	Especially for service rooms, bath, wainscots	Many rich, glossy colors. Tile and board patterns. Resistant to shocks, dirt, staining. Bends to large curves. Can be fitted against trim. Easy to handle	Rather hard to cut. Dulls tools

HOW TO SELECT WALL COVERINGS

Kind	Size and Thickness	How to Apply	Recommended Uses	Advantages	Disadvantages
METAL TILE	4¼, 8½ in. square	Cemented to backing	Wainscots, showers, bathrooms, kitchens	Rich, sparkling colors; easily fitted; durable. Waterproof. Easily cleaned. Resistant to dirt, ordinary solvents, stains	Can be scratched and dented
CERAMIC TILE	Various: typical, 1¼, 4¼, 8 in. square	Cemented, usually only professional application	Wainscots, showers, bathrooms, kitchens	Rich, sparkling colors; durable. Abrasion and puncture resistant. Fireproof. Waterproof. Easily cleaned. Resistant to dirt, ordinary solvents, stains	Brittle, hard to cut and fit, slightly irregular, mortar grout may flake out
VINYL SHEETS	1/20 in. thick, 54 in. wide, in rolls	Cemented to backing. Metal or hardboard trim	Wainscots, bathrooms, kitchens	Good selection of colors; durable. Abrasive and puncture resistant. Easily cleaned. Easily fitted	Can be cut
VINYL TILES	1/20 in. thick, 8 in. square	Cemented to backing. Metal or hardboard trim	Wainscots, bathrooms, kitchens	Good selection of colors; durable. Abrasive and puncture resistant. Easily cleaned. Easily fitted	Can be cut
LINOLEUM-TYPE SHEETS	1/20 in. thick, 36, 54 in. wide, in rolls	Cemented to backing. Metal or hardboard trim	Wainscots, kitchens, bathrooms	Large variety of glossy bright colors and tile and board colors. Fairly easily fitted. Easy to clean. Inexpensive. Trim not removed	Easily torn in applying
LINOLEUM-TYPE TILES	1/20 in. thick, 9 in. square	Cemented to backing. Metal or hardboard trim	Wainscots, kitchens, bathrooms	Variety of colors and patterns. Easily handled and fitted. Inexpensive. Trim not removed	Joints must fit
CORK TILES	⅛ in. thick, 9 in. square, 6x12 in.	Cemented to backing	Wainscots, walls	Tan color blends with most decor; easily cut and fitted. Easily handled. Trim not removed. Resilient	Only one color. Stains and dents easily
PIGSKIN TILES	⅛ in. thick, 4½ in. square, 4½ by 9 in. Smaller available. Special sizes cut	Cemented to backing	Wainscots, walls	Tan color blends with most decor; easily cut and fitted. Easily handled. Trim not removed. Resilient	Only one color. May shrink





joints are made in the boards, or if they are put on horizontally, use splines and butt joints. Select for sequence of color and grain. As a slight lap-effect is gained, decide in which direction it is to be. Boards can be scribed to fit against the ceiling, or they can be fitted between horizontal members such as ceiling molding and baseboard.

Joint placing, trim fitting, and use of moldings similar to those for solid-wood paneling can be put into practice when installing pre-finished plywood boards. Seal backs of boards and, on outside walls, use a glossy, asphalt paper vapor barrier in addition, under boards, or over furring strips where used.

While inexpensive, unfinished tongue and groove hardboard boards make a neat wall surface that can be painted, it also can be waxed for a natural finish. Install it over plaster with nails and cement, or on bare studs or furring strips, with nails or staples driven into the tongues.

Sheet hardboard is applied by cementing, cementing and nailing, or nailing (or screwing) over solid backings, studs, or furring strips.

The perforated hardboards so popular for display backgrounds, tool and utensil racks are handsome in their own right as wall coverings. Space framing members 16 inches apart, maximum. Where holes fall over solid supports, the studs can be painted black for the appearance of a hollow space, or the support may be grooved where line of holes falls for brackets insertion.

For normally humid conditions, unwrap hardboard panels and place them separately on edge lengthwise around the room for 24 hours before installing. If they have been abnormally dried, as when shipped from an arid locality, scrub cold water into the texture side of each piece with a stiff broom, pair texture sides together, stack and cover with a tarpaulin for 24 hours.

Tempered boards to be installed in kitchens and bathrooms, where fluctuating humidity conditions occur, should be stacked with two thicknesses of wet newspaper over each face, and covered with a tarpaulin for 24 to 36 hours. This conditioning is also recommended if the atmosphere is materially dryer than usual, as

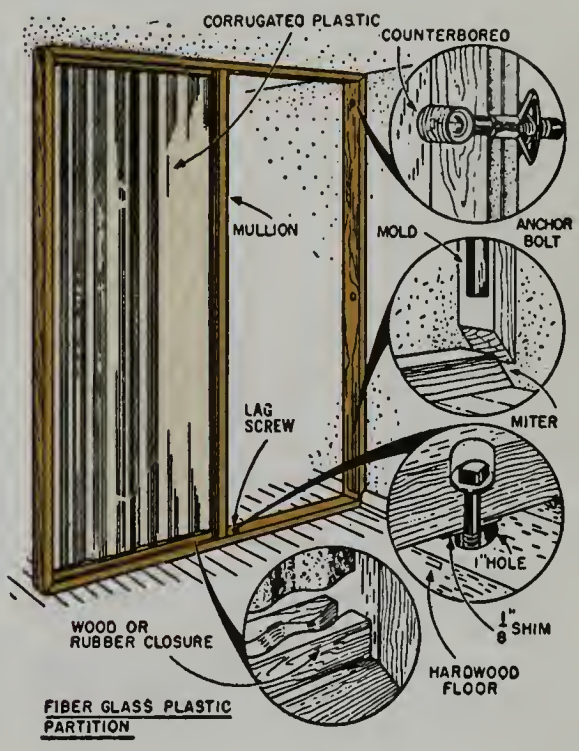
when there has been a lack of rain for some time.

Install ⅜-inch chip-core, hardboards much like plywood, nailed and glued to ¼ by 2½-inch plywood furring strips nailed to studs and around openings, or else over furred plaster, all joints over furring. Over masonry, install 2 by 3-inch furring plumb and level, and seal backs of panels with spar varnish or primer-sealer paint just before installing. For added protection, use asphalt-impregnated vapor-barrier paper under furring.

Insulating wallboards. Insulation-type wallboards are inexpensive and light to handle. Their textured surfaces are available in many prefinished colors and they can be applied in almost unlimited patterns. Having excellent insulating properties, they are often substituted for other types of insulation. While easily marred, most walls are rarely subject to puncturing shocks, and where this possibility exists, these boards can be applied above a hard-surface. This product is installed over furring strips, or directly over rough framing; boards are secured with nails through the tongues, or stapled. Some brands are clipped. The safest method of installing a ceiling with regular courses is to start from the center and work toward the edges, either by centering a joint or a square. As the material is soft, care must be taken to force each joint with the same pressure, or the courses will run seriously, so keep constant watch and loosen or tighten joints as irregularities in joints appear. Square-edge sheets are joined without attempt to disguise joints, usually covered with flat or contour batten.

Fiberglass panels in several colors with various degrees of light transmission are available in thin sheets, mostly corrugated like sheet metal, but are also available flat with ribs. Popular for outdoor walls, they have indoor uses, as well. While they can be applied to walls as coverings, a better use is to employ these panels as complete walls, in such places as dividing partitions between breakfast room and kitchen, dining area and living room, and the like. The panels are rigid enough so that they require support only at top and bottom. Vertical and horizontal installations require a frame of 2 by 3- or 4-inch members. Nail top member through crossing joists or, if it parallels them, use anchor bolts countersunk flush. If the base member is mounted on a hardwood floor, particularly blocks, bore 1-inch holes in the flooring to permit expansion movement, place ⅛-inch shims under the base and tighten ¼-inch lag screws lightly. Nail wood or rubber closure strips against faces of the plastic at top and bottom, and bind edges with quarter-rounds, base shoe, or other molds. If two or more widths of panel are required, install a mullion or mullions between.

See also: ADDITIONS, HOME; ATTIC; BASEMENT; GARAGE REMODELING; HOME IMPROVEMENT; ROOM DIVIDERS; WALLBOARD.



How to Build with Translucent Panels

Roofing a patio or erecting a translucent fence are only two of the many projects you can complete with easy-to-use panels of durable, maintenance-free fiberglass

THE STRUCTURAL STRENGTH and beauty combined in modern translucent fiberglass and plastic panels enable today's home owner to enhance indoor and outdoor settings with paneled structures that provide soft, glare-free light and do not darken adjacent areas.

These translucent panels are made to order for patios, awnings, sun porches, fences, partitions, shoji screens, room dividers, and many other projects that require light transmission.

Fiberglass in panels or roll form is lightweight, shatterproof, and manufactured in corrugated, shiplap, flat, and other configurations. It stands up well under wet and dry conditions and will not warp or rot. Any dirt or dust that does collect on the smooth surface can be hosed off. Decorative fiberglass and plastic panels used indoors that are clear or embedded with natural materials such as butterflies, leaves, ferns or grasses can be maintained by periodic washing with soap and water or ordinary detergents.

Cost depends on locality and type of structure. In areas where climate is generally mild, framing can be light and less expensive than a more substantial understructure.

Patio. Construct the patio cover by nailing or lag-screwing the 2 x 6 header directly to the house studs. If the house is masonry, other than stucco, drill holes with a carbide tipped bit and install expansion sleeves to receive the screws. Corrugated wood strips that you can buy or make are placed across the framing to assure a mating fit for the overlapping fiberglass panels.

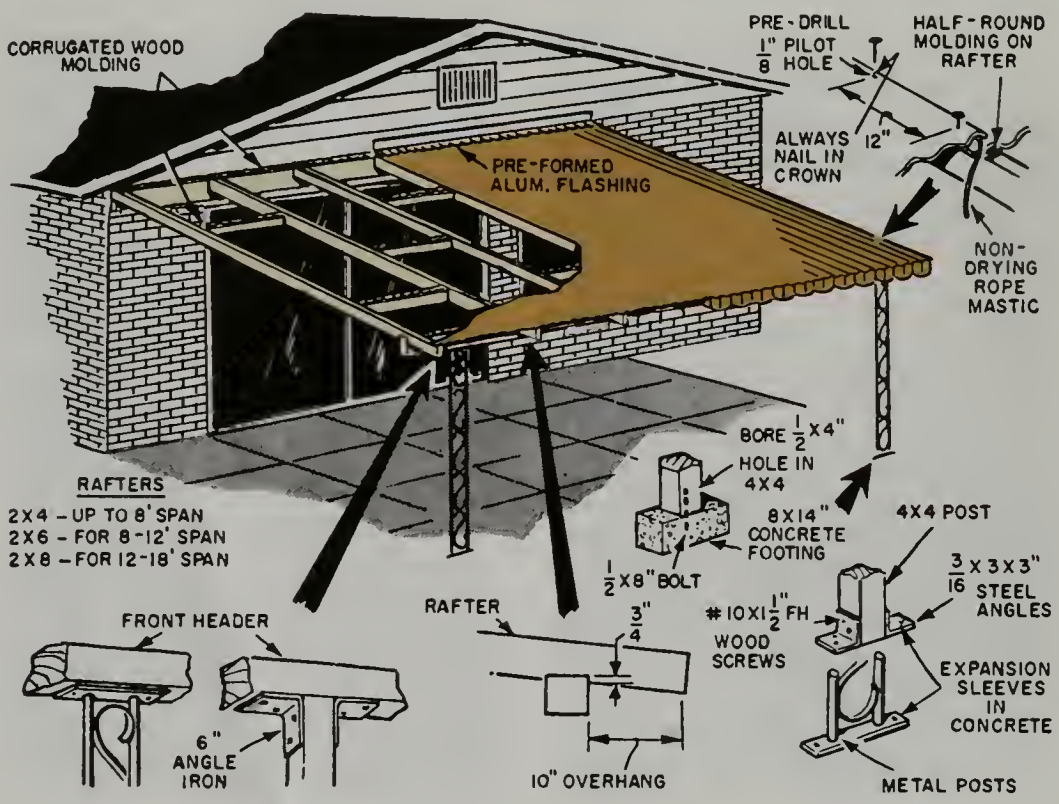
Avoid heat traps by providing sufficient ventilation at the roof of the structure. Outdoor structures that abut the roof of an existing structure should be set 6 to 8 inches below the eaves and about 6 inches back so the warm air can escape. If this brings the patio roof too low, raise it higher than the house roof and support it on braces. Leave vent openings between the sheets in the side valances so air and insects can get through.

Vertical walls can be ventilated by leaving openings at the bottom and top to provide for air circulation. When the wall supports an overhang, ventilation is provided by openings between the beams and rafters. When possible, position the structure so prevailing breezes will give a cross ventilation.

Cut the panels with either a power saw that's equipped with a blade recommended for such work that will give a finished edge, or with a fine-tooth hand saw. Mark the cut line on the fiberglass panel with a grease pencil or scratch it with a nail or scoring awl.

Before cutting any panel lengthwise, lay them all on the ground so they cover the spread needed. If a panel must be cut to fit, plan to use narrower strips at the ends rather than starting with a full sheet and cutting the last sheet to fit no matter what its width may be. When determining the spread, be sure to allow two inches for sheet overlap.

Install the panels by laying the first panel on the corner, and make sure it is square with the rafter. Allow for at least a two-inch overhang at the front. If the area to be covered is longer than the panel, work from front to back with the 4- to 6-inch overlap sealed with a strip of non-drying



Secure posts to anchors embedded in concrete in patio slab.

T-shaped anchors can be used to join header and front posts.

Cross supports will distribute stress within structure, help panels bear snow loads of up to 100 pounds per square foot.

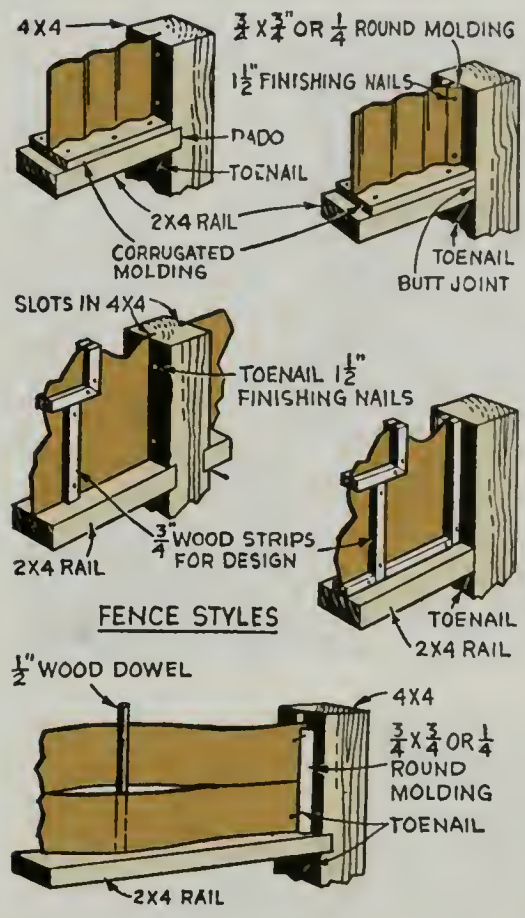
Molding shaped to mate with panel corrugations goes on top of crosspieces.

Apply caulking to panels before raising them into place.

Special washers laminated of metal and neoprene add strength, reduce the possibility that cracks will start to form at nail holes when the structure is under any stress.

Nail panels through crowns of corrugations only. The panels are nailed in place with each succeeding panel overlapping the preceding panel by one corrugation.

Use an ordinary hand drill or small power drill to pre-drill nail holes.



rope mastic across the corrugations. If you cannot nail the overlap to a rafter, use weatherproof acorn nuts and bolts to secure the two sections.

Drill all nail holes with a ⅛-inch bit to avoid localized crazing marks that can be caused by nailing directly through the fiberglass. Nail only through the crown of the corrugations, and every 12 inches along the rafters, and every second or third corrugation along the headers, braces, and rafters. Where panels overlap, nails should pass through the rope mastic to ensure a weatherproof joint.

In areas where high wind velocity or heavy snow loads must be considered, use special washers of laminated metal and neoprene under each nail. For additional strength, space the aluminum nails every 6 to 8 inches along the rafters.

Fence. Design fence frames to fit standard widths and lengths of the fiberglass panels. The styles of fences built with these translucent panels are unlimited. Use flat or

▲ *Stain or paint posts and rails before assembly. The 2 x 6-inch lumber for fence will be used double for posts, singly for top and bottom rails. Coat the ends of posts to be set in ground with wood preservative, or purchase lumber that has already been treated.*

▲ *When building a fence, use a staked string and a carpenter's level for accurate placement. Board lying between post was used to space posts exactly three feet apart (inside dimension) to accommodate three-foot-wide panels.*

Installing translucent panels between fence posts. Horizontal rails are grooved to accept edges of flat panels.

Top rail of fence goes into place over flat translucent panel.

corrugated panels, or combine both for a more unusual effect.

If possible, base your design on the standard sizes of the panels to avoid unnecessary cutting. Use 4x4 wooden posts and space them 8 feet apart. The posts should be treated with creosote and set in concrete two feet deep. Use grooves or wood stops to hold panels in place.

Greenhouse. A low-maintenance greenhouse sheathed with nine sheets of 10 foot translucent panels admits glare-free, shadow-free daylight and diffuses it evenly over every inch of growing area. These

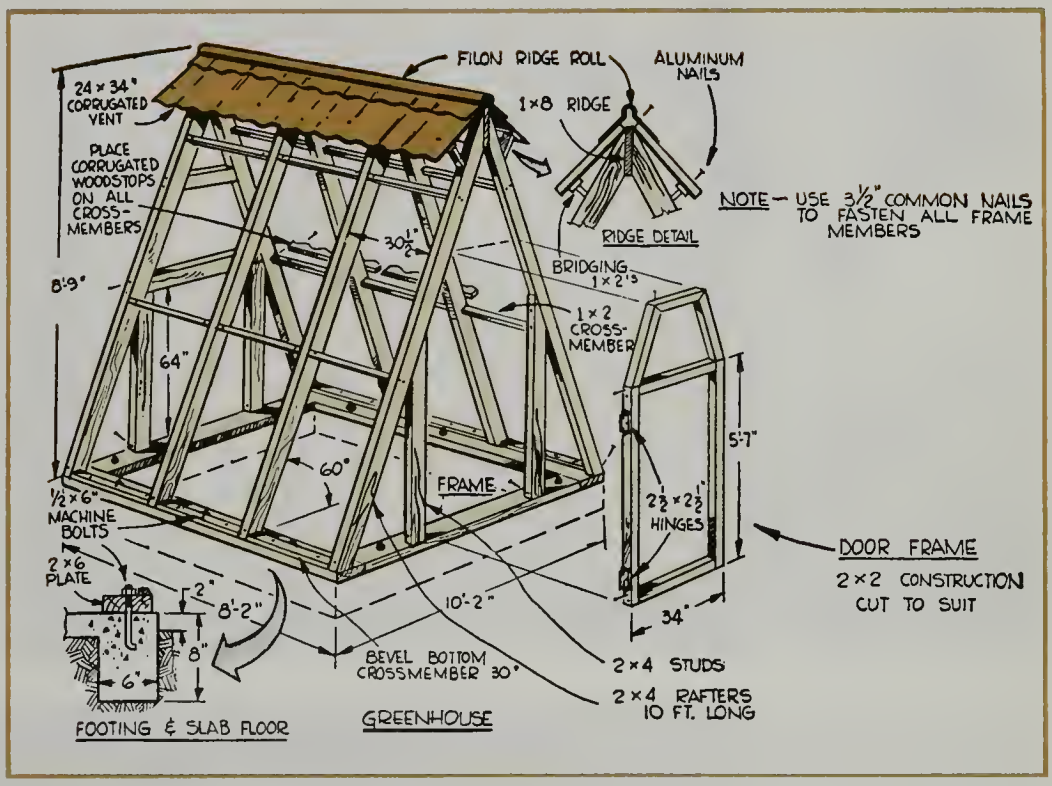
Corrugated molding is nailed to post on each side of corrugated glass-fiber-reinforced panel. Molding is available where paneling is sold.

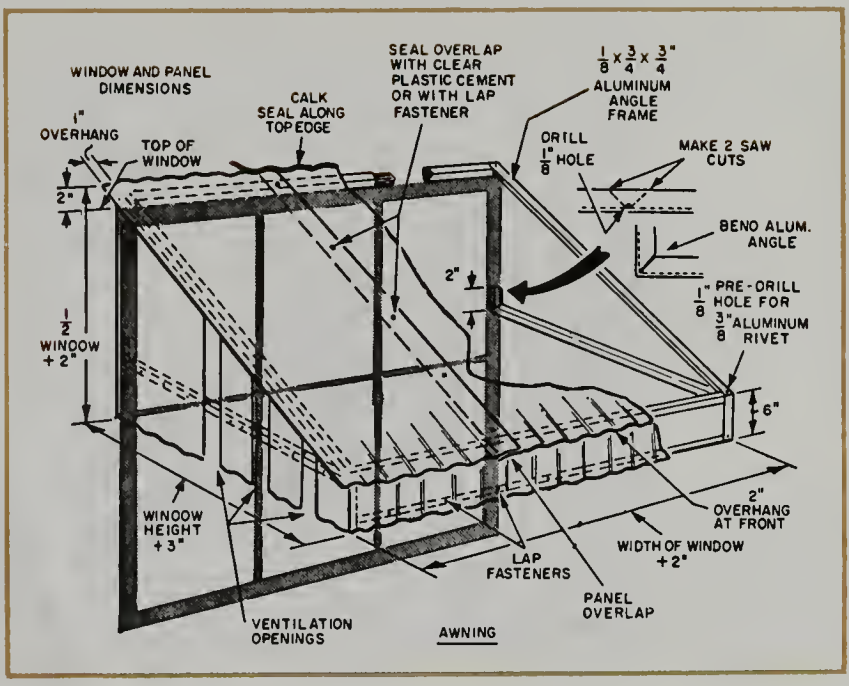
panels also minimize heat loss in winter and reduce sun heat in summer.

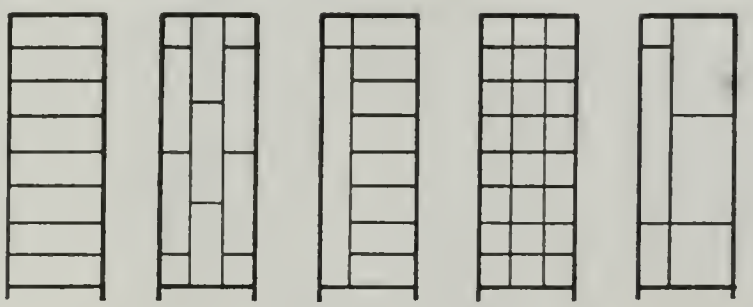
First step is to dig a 6x8-inch trench around the slab area for a footing. The cement form should extend two inches above ground level, with ½ x 6-inch bolts placed in cement when the slab and footing are poured.

Bevel the top and bottom of the 10-foot long rafters and nail the 1x2 crossbraces to the rafters at the bottom and at 4 and 9-foot heights with common nails. Raise the

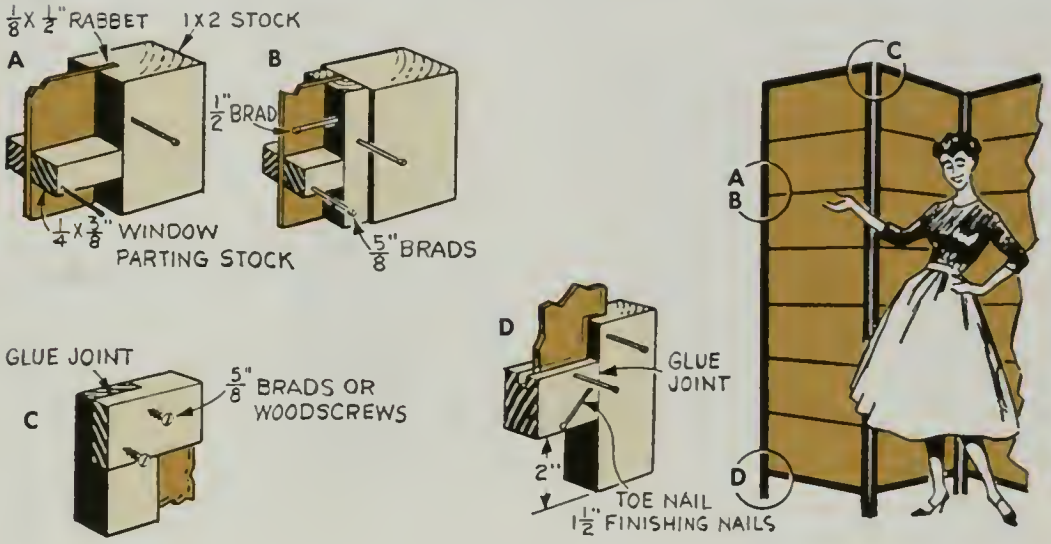
The completed fence of corrugated and flat panels. The striking design provides privacy without blocking off light from either side. The flat panels were reinforced by nailing ¾ x ¾-inch wood strips in each side.


FILON RIDGE ROLL
ALUMINUM NAILS
1×8 RIDGE
24×34" CORRUGATED VENT
PLACE CORRUGATED WOODSTOPS ON ALL CROSS-MEMBERS
RIDGE DETAIL
NOTE — USE 3½" COMMON NAILS TO FASTEN ALL FRAME MEMBERS
30½"
BRIDGING 1×2'S
8'-9"
1×2 CROSS-MEMBER
64"
5'-7"
60"
FRAME
½×6" MACHINE BOLTS
2×6 PLATE
2½×2½" HINGES
DOOR FRAME
2×2 CONSTRUCTION CUT TO SUIT
2"
8'-2"
10'-2"
34"
8"
6"
BEVEL BOTTOM CROSSMEMBER 30°
2×4 STUDS
2×4 RAFTERS 10 FT. LONG
FOOTING & SLAB FLOOR
GREENHOUSE


WINDOW AND PANEL DIMENSIONS
SEAL OVERLAP WITH CLEAR PLASTIC CEMENT OR WITH LAP FASTENER
⅛×¾×¾" ALUMINUM ANGLE FRAME
CALK SEAL ALONG TOP EDGE
1" OVERHANG
TOP OF WINDOW
DRILL 1" HOLE
MAKE 2 SAW CUTS
2"
BENO ALUM. ANGLE
2"
⅛" PRE-DRILL HOLE FOR ⅜" ALUMINUM RIVET
½ WINDOW + 2"
6"
WINDOW HEIGHT +3"
2" OVERHANG AT FRONT
WIDTH OF WINDOW +2"
LAP FASTENERS
PANEL OVERLAP
VENTILATION OPENINGS
AWNING



SHOJI SCREEN DESIGNS



sides and toenail to the 1x8 ridge member and bottom sole plate. Install the back braces and nail the corrugated wood stops to the crossbraces and rafters.

Cut six 9-foot panels out of the 10-foot sheets. Place each of the 34-inch wide panels on the rafters using one corrugation overlap between panels. Insert rope mastic between the panels at each overlap before nailing to assure a weatherproof joint. Nail every 12-inch on the rafters and through the crown on every third corrugation over the crossbraces.

Build the door frame out of 2x2s and attach the framepieces with angle, straps. Screw the 2x2-inch hinges on the door frame and to the shelter framework. Cut three pieces from the remaining panel to fill in the areas on the sides and top of the door frame.

Awning. Only a light understructure is required for a fiberglass awning that permits soft diffused light to stream through your windows. Make a sketch of your window to scale and use these dimensions as a base to lay out the fiberglass sections.

Make the frame by cutting ¾ x ¾-inch aluminum angle to length, then notch and bend the corners to shape. For the header, rip a 1½ x 1½-inch piece of pine at a 45° angle and cap it with an aluminum angle. Assemble the frame with ½-inch aluminum bolts and fasten the top panel to the frame with ⅝ x 8-inch sheet metal self-tapping rust-proof screws.

Use 3-inch aluminum nails to attach the

wood header 2-inches above the window frame. Space the drilled holes that go through the awning and top edge 6 inches apart for the 1-inch aluminum wood screws that are used to join the roof to the header. Fasten the awning to the building with 4-inch wood screws to make it secure.

Interior. Interior uses for fiberglass and plastic panels include fixed or movable dividers or luminous ceilings that give you soft wall-to-wall lighting.

Illuminated ceilings diffuse the light, spreading it rather than allowing direct beams to concentrate in one area. This soft lighting can be used to brighten the bathroom, kitchen, or hallway and eliminate many shadows and harsh glare.

Translucent panels inserted between the studs or dropped from the ceiling can be supported with aluminum or 1 x 3 wood strips. Install the fixtures so each lamp spreads light in a wide area.

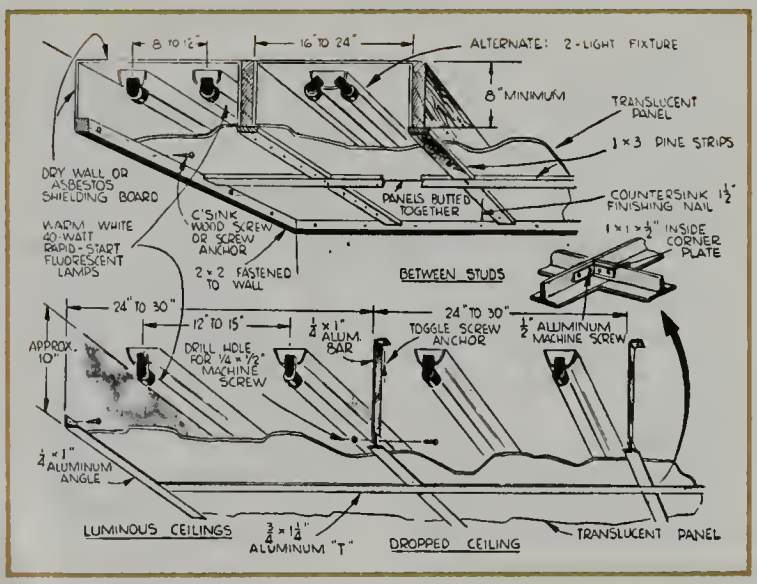
Panels may be arranged in any width up to 3 feet, and the length can be up to 10 feet providing the panel is reinforced so it will not bow.

Screens. Modern shoji screens can be made of solid color panels or those imbedded with decorative materials. Precut the frame pieces to length, completely assemble the components on a flat surface, and check for correct fit without nailing any of the parts. When everything fits properly, finish them individually with a good grade of flat black enamel. After they dry, assemble with finishing nails or ⅝-inch flat head wood screws.

One type of frame construction requires that the frame be completely assembled around the panel before the corners are secured. Or, the panel can be held in place with ¼ x ⅜-inch window parting stock. Use ⅝-inch finishing nails to attach the stock to the panel and 1x2 frame. Drill pilot holes spaced 4 to 6 inches apart and drive in the finishing nails.

Any looseness or rattle of the panel can be eliminated by filling excess spaces with a paste wood filler or window putty. Set the hinges about 6 or 8 inches from the top and bottom, and center the third hinge. Attach hinges to one frame and mark the position on adjoining frame after butting frames.

See also: BREEZEWAYS; CONCRETE BLOCKS; DECKS; FENCES; HOME IMPROVEMENT; PARTITIONS; PATIOS; ROOM DIVIDERS.



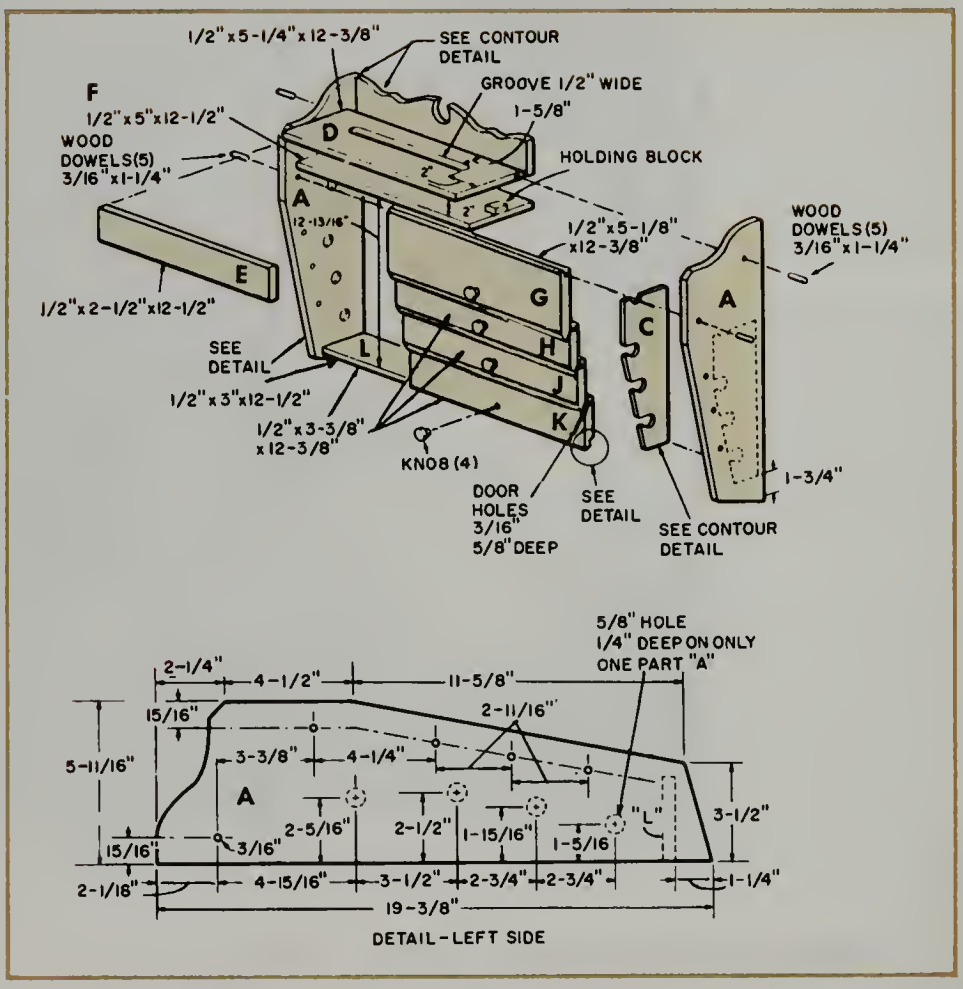
Build a Kitchen Paper Dispenser

It only takes a few hours to make this unit which will keep tissue, foil, towels and the like out of sight but at your fingertips

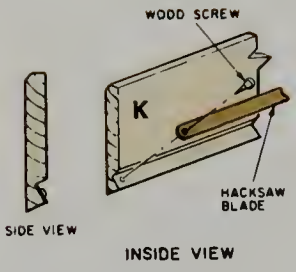
THIS DECORATIVE UNIT needs just a little wall space, and it keeps all your kitchen wrapping material, and your tissues, in one convenient location. The little dispenser cabinet holds a standard box of tissues in a top compartment, and rolls of paper towels, waxed paper, aluminum foil, and plastic wrap can be fed out through individual doors on its front.

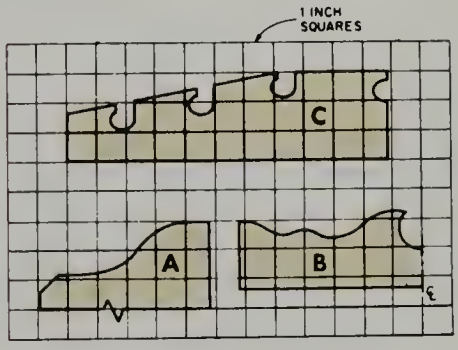
There's nothing difficult about this project. It can be completed in a few hours, using common hand tools. The secret of getting a professional-looking job is use of plywood with the veneer finish of your

parabolic microphone: see microphones
parquet floors: see floors, tiling



▲ *Assembly detail and detail of left side of the paper dispenser. Flexible wood tape is available to match plywood veneer you choose—mahogany, maple, birch, etc. It should be used to cover exposed plywood edges.*





▲ *Make up full-size patterns, as shown. Cut plywood with a jig saw or saber saw and smooth edges with sandpaper or rasp. For cutting plastic wrap, attach a hacksaw blade.* ➤

Build a Kitchen Paper Dispenser *1893*

choice (birch, oak, mahogany, maple, etc.) and matching flexible wood tape. The tape is used to cover all exposed plywood edges, and a good contact cement is all that's needed to bond the tape in place. When the cabinet is stained and varnished, the finish on the tape will exactly match that on the plywood surface.

Make up full-size patterns. Trace the two side pieces (A) and the top molding (B) on ½-inch plywood, and rod holder (C) on ¼-inch plywood. Cut these out with a saber saw or jig saw, and sand or wood-rasp the edges until they are smooth and square with the plywood surface.

Cover the top scrolled edge of the molding with wood tape, then the exposed edges of the two side pieces. Mark for the 3/16-inch holes on one of the side pieces, clamp the two pieces together, and drill through both pieces.

On the inside surface of only one of the side pieces, drill the four ⅝-inch holes to a ¼-inch depth, as shown. Cut out rod holder (C), drill the matching holes in it, and attach it to the inside of the second side piece.

Cut out parts (E), (F), and (L), all to the same width as top molding (B). Apply flexible wood tape to the front edge of part (L), the dispenser base piece. Now assemble the top molding, base piece, top shelf (F) and front piece (E) to the two end pieces. Use 1½-inch finishing nails; set the heads below the wood surface and cover them with wood putty that matches the wood veneer.

Now cut out lid (D) and doors (G), (H) and (K); each is ⅛-inch shorter than molding piece (B) to allow for clearance between the end pieces. Cut the slot in lid (D) for the tissues, and bevel the upper rear edge. This will allow the lid to be raised without rubbing against the top molding. Cover the lid's front and side edges with wood veneer.

Bottom edges of doors (G), (H) and (J) are beveled to a point, and the sloping edges are covered with the flexible wood trim. Cut a notch along the inside bottom edge of door (K) as shown, and attach a hacksaw blade for cutting plastic wrap. Note that the bottom edge of this door is beveled on the inside.

Drill 3/16-inch holes to a depth of ⅝-inch into the side edges of the lid and doors, as illustrated. Cut ten 1¼-inch lengths of 3/16-inch dowel, and use these to attach the lid and doors to the dispenser. Put a little glue on the outer ends of the dowels, and push them through the holes in the end pieces, and into the lid and doors.

Cut four ½-inch dowels to the inside length of the dispenser to support the rolls of paper towels, foil, etc. Place a tissue box in its compartment, and nail a small block of scrap wood to part (F) at each end of the box, to keep it centered. Attach cabinet pulls of your choice to each of the doors.

Remove the tissue box, and give the dispenser the desired finish. Use at least two coats of varnish or other finish, and sand lightly before each is applied.

Original design by Steve Ellingson.

MATERIALS LIST

Quanity	Size and Description	Purpose
1	½" 2'x4' plywood veneer	basic unit
2	½"x3' hardwood dowels	supports
1	3/16"x3' hardwood dowal	lid and door holders

NOTE: Also need flexible wood trim, drawer knobs, 3d finishing nails, glue and hacksaw blade.

How to Make and Cover a Parsons Table

This handsome modern table is not difficult to make. You can cover it with fabric, as shown here, or finish it in some other way if you choose

YOU CAN CREATE an unusual decorative piece of furniture by resurfacing a table with fabric. A Parsons table, with its simple, straight lines is well suited for this kind of project.

You can start from scratch, constructing a table for the purpose, or you may have an old one on hand that requires a new look. If you choose to redo an existing table, you need to remove the old finish down to the bare wood before resurfacing it.

Nearly any fabric can be used, as long as it not so thin that overlaps will show through and not so thick that the overlaps will form pronounced bulges where the edges are tucked in.

The project requires a spray adhesive especially designed for the purpose—one that makes a permanent bond quickly, but not immediately. The slight lag in bonding is necessary to give you time to make slight adjustments or to completely remove the fabric—in case of a major error—and start over again. Consult your hobby store about adhesive types.

Laminating with ordinary wet glues or contact cement is not recommended. Wet glues will not bond the cloth intimately unless clamping pressure is used, forcing the glue to penetrate the surface. The major disadvantage of contact cement is its instant gripping action. It allows no opportunity for adjustments.

For a neat, finished look, all raw edges of the fabric should be turned under at least one inch. Sewing is not necessary; simply spray a band two inches wide along an edge, allow it to get tacky (about one minute), then press together.

The table is covered in two phases, the top in one piece and the legs separately. Work on the top first. Measure the width and both side thicknesses of the table and add to this the extra two inches for turning under. To determine the long dimension of the cloth add both side thicknesses to the length plus an additional 10 or 12 inches. This is to allow the ends to reach down and around to the inside surface of the table ends. Do not make the one inch folds on the ends of the cloth.

Fit the cloth so the end of the fold meets flush with the bottom edge of the wood. The ends get a "hospital corner" treatment. Don't try to cover the top in one operation.

parting tool: see lathe

How to Make and Cover a Parsons Table

1895

◀ *Square leg can be made by joining two blocks. Use temporary nail to keep pieces from sliding and apply clamp pressure.*

▼ *A jointer saves time in truing and sizing leg blocks. Otherwise, you will have to use a hand plane.*

▲ *Widen narrow board for top by adding pieces. Dowel holes can be drilled in perfect alignment if piece is clamped as shown.*

▶ *Brush glue on both surfaces and get some in the dowel holes.*

1896 *How to Make and Cover a Parsons Table*

Join the pieces and hold them together with bar clamps until the glue is set.

Use temporary nails to hold leg in alignment. Then, counterbore a large shallow hole to accommodate lag screw head and bore pilot hole for the screw.

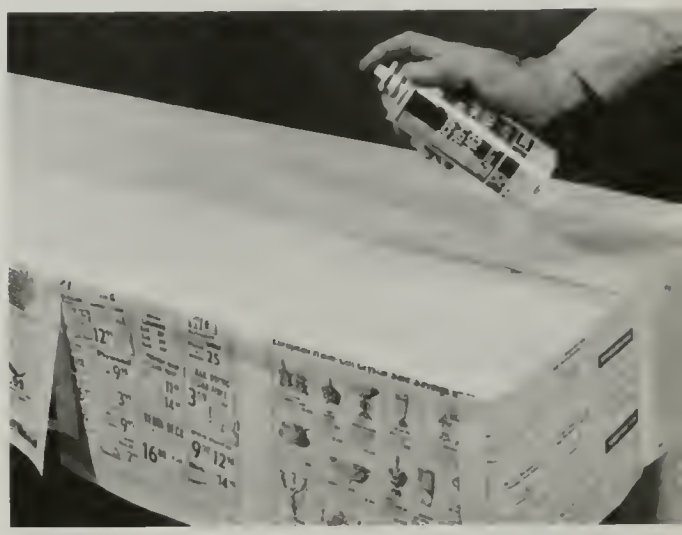
Counterbored hole should have a diameter large enough to accept socket wrench. Heavy lag screw takes place of the clamps when the leg is glued. Later, fill hole with wood putty.

Keep legs in place with lag screws and temporary nails while fitting and gluing side pieces. Nails and glue are sufficient for these pieces. Fill in the screw head holes on top.

How to Make and Cover a Parsons Table 1897

Apply glue to all surfaces of joint and leg that make contact. Then, join the pieces, using the lag screw to hold leg in place. Clamps are unnecessary.

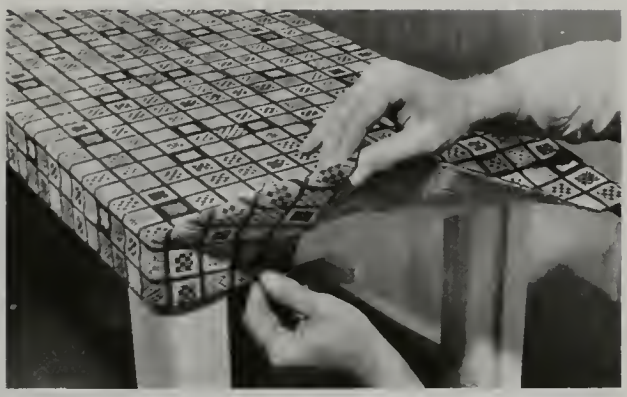
For laminating fabric to wood, the application of adhesive is easy. Just spray it on with tip of can held six to eight inches from the wood. Move it slowly and use newspaper to mask parts where adhesive is unwanted.



Spray cloth and table top. Do one half at a time, as shown.

Spray adhesive on long edges of fabric and fold over one inch.

1898 *How to Make and Cover a Parsons Table*



Finish off each end as shown. Make two 45-degree folds, secure ends of cloth to table. Add more adhesive and pull the flap down, under, and around to the back.

Instead, work in sections. Apply a coating of adhesive to half of the table top, lengthwise, and to one of the sides. Coat the same portions of the fabric. Wait about one minute to allow the adhesive to become tacky, then join. Repeat the procedure with the other half. You can tackle smaller portions if you prefer, until you get the hang of it. Tape single sheets of newspaper to mask off sections where adhesive is unwanted.

The ends are next. Make 45 degree folds at both corners, coating with adhesive as you go along. Due to the build-up of accumulated cloth layers at the ends, you may want to build up the center portions which will be slightly depressed. Make up a filler with scrap cloth and insert where needed to relieve the depression. Do this before completing the hospital corner.

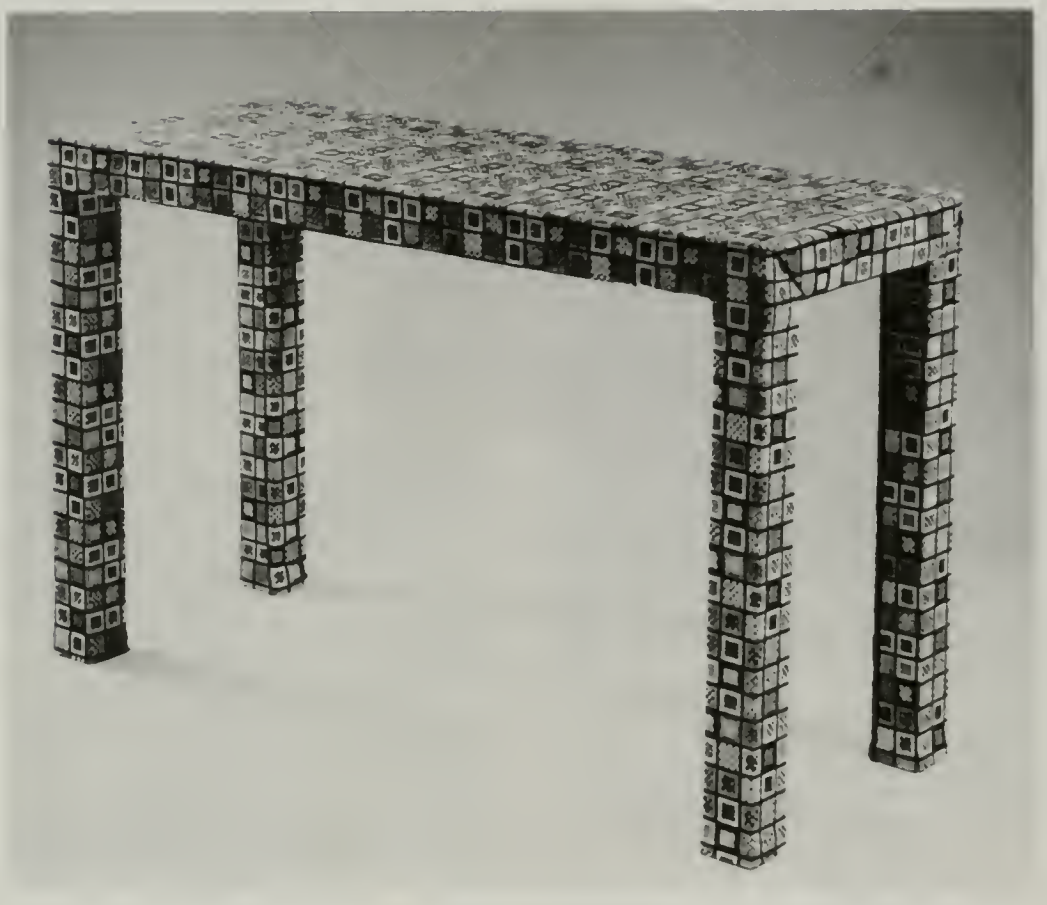
If possible, the fabric for the legs should be cut so the selvage can be used as a finished, exposed edge. Cut each leg piece two inches extra in the length and turn over an inch top and bottom. The width should be equal to 4½ thicknesses of the leg to allow ample overlap. Mask off the finished top areas with paper, apply adhesive. Apply the fabric butting the top edge firmly to close the joint between leg and sides. An additional spray of adhesive will be necessary at the overlap portion of the leg. Determine how far the selvage will reach, mask off the area beyond, then spray. Be sure to get adhesive onto the selvage.

If you don't have a Parsons table you can make one. The one illustrated here is 18 x 48 x 30 inches high with 2¾-inch

Be sure to mask top fabric while spraying adhesive on leg.

Work three sides of the leg first, leaving the flap with the selvage end until last.

How to Make and Cover a Parsons Table *1899*



▲ *The completed table.*

thick sides and legs. You can alter the dimensions, but the sides and legs should be of the same width.

Use 1½-inch poplar, doubling up to make the squares for the legs. Because, none of the wood remains exposed, you can cut costs by using less expensive lumber such as fir plywood for the top and kiln-dried 2 x 4s for the legs. Use well seasoned lumber to prevent warping.

To make a solid lumber top, join several boards with butted dowel joints. Square the ends of the legs accurately then temporarily tack nail the top onto the legs to facilitate drilling holes for a ⅜ x 3-inch hex head lag screw. Counterbore a hole large enough to receive a socket wrench for driving the screw. Bort just deep enough so the head with washer rests a bit below the surface. Later the hole can be filled with wood putty or spackle.

Temporarily attach the legs while custom fitting the built-up sides. Use nails and glue to secure the side pieces. Apply glue to all contact points of legs, sides and top for a lasting joint. Insert the lag screws to draw the legs up tightly. The lag screw eliminates the need for clamps. Fill in the screw head holes on top. Sand the top and legs, if necessary, to true up. Don't apply any finish coats. The table is ready for covering.

See also: ADHESIVES; SERVERS; TABLES.

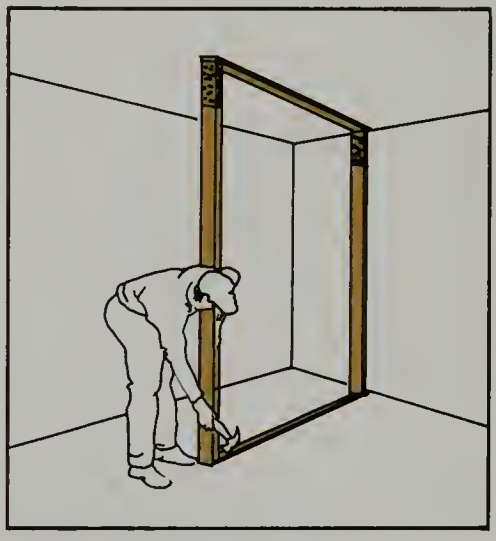
How to Make Spring Pole Partitions

These versatile devices can be used to erect room dividers or support shelves or construct a new wall quickly without elaborate framing

SPRING-LOADED POLE and lumber tops make it possible for the home handyman to erect inexpensive and sturdy partitions and make a multitude of pole fixtures in less time and without the usual time consuming construction procedures associated with making a permanent structure.

Several types of pole-top spring fixtures are available for this type of construction. One type, made of steel, is used with dressed 2x3s to erect partition walls or storage shelves without holes in the floor or ceiling. Another is used to make pole fixtures. It is 7 inches long and made of kiln-

First step when making partition is to place 1x3s on floor, then use spring-loaded 2x3 to wedge the 1x3 against ceiling.



Use level to ensure that first two 2x3s are exactly perpendicular, then tap the 1x3s into proper location on guide line.

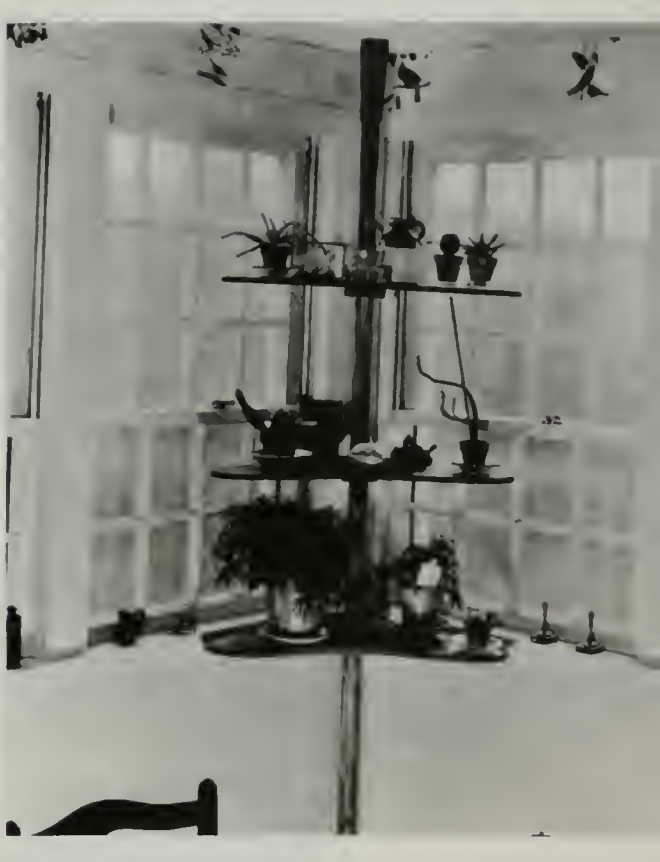
dried birch or maple that can be painted, stained or varnished.

All you have to do is slip the spring-loaded top on the pole or 2x3, push it against the ceiling, and you have a sturdy vertical support that can be moved whenever you want to without leaving such tell tale marks as nail or screw holes on the ceiling. A soft protective pad on the top prevents the ceiling from being marred, and another pad that's inserted under the bottom protects the floor and prevents the vertical member from moving.

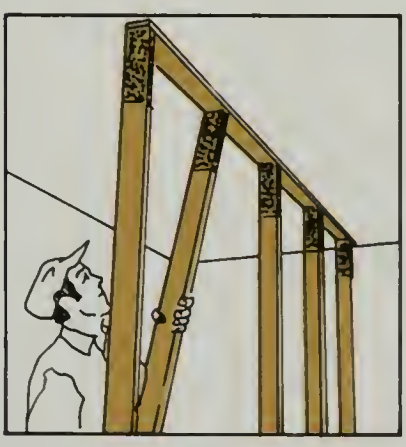
Once the spring-loaded 2x3s are in place, you can nail wallboard or plywood sheets to both sides to make a solid wall. It is necessary to butt the wall while nailing, but once the intergraded wall is up, there is no problem of it moving.

You can make the least expensive spring pole on the market by using the pole type fixtures. Most lumber yards sell the 1⅝ inch diameter poles that are used with this unit. You can make poles that can be used as room dividers, clothes trees, what-not shelves, pole light assemblies, and other sturdy and decorative fixtures.

When you saw the pole or 2x3, be sure to cut the floor end square so the upright



By installing a series of shelves you can make an attractive pole fixture that can be used for plants or a what-not shelf.



Spring the remaining 2x3s into place about two feet apart. Space between members is not critical here.

Wallboard or plywood can be nailed to the frame once it is positioned. Butt the other end while nailing to avoid shock movement.

has a firm footing at the base. It must be square so the pressure will be evenly distributed on the protective pad that prevents it from slipping.

Cut the upright 3 inches shorter than the height from the floor to ceiling. If you think it is too hard to spring it into position, then just cut another half inch or more off the top end. If by accident you cut it too short, just cut a disk of the right size from the cut-off and slip it into the topper before inserting the upright.

For more information on these fixtures, see your lumber or hardware dealer.

See also: PANELING; ROOM DIVIDERS; WALLBOARD.

A series of 1/2-inch dowels driven into this 1 5/8-inch pole between counter and ceiling ends pot and pan clutter in the kitchen.

Springs are inside these metal compression units. This kind of spring pole and accompanying fixtures are available at some department stores and houseware dealers.

Replacing carburetor begins with removal of complete air cleaner assembly. On late-model cars this involves several hose disconnections and perhaps loosening or removing bracket(s).

How to Change Engine Parts

Slice a healthy chunk from your auto repair bills by exchanging worn out parts for rebuilts and installing them yourself

WHEN YOUR CAR needs a new generator, starter, fuel pump, carburetor, transmission, or engine, you can replace it with an exchange unit, doing the removal and installation yourself to save a big part of the repair bill. Buying rebuilts is convenient when you don't have the time, tools and/or know-how to rebuild your own.

In addition, many parts houses give discounts from list price to weekend mechanics, though professionals do, of course, receive large ones.

The exchange unit is a rebuilt. At one time, rebuilts were very risky purchases. But today, there are excellent assembly-line and semi-custom, rebuilders all over the country, and their products are reliable.

There also are poor rebuilts. Take a carburetor for example. A "cheapie" rebuilder will merely clean out the old carburetor, replace the gaskets and perhaps the needle valve and seat assembly. A quality rebuilder will replace power valves, jets, accelerator pump and choke too.

With a fuel pump, the cheapie rebuilder will just replace the pump diaphragm. The quality rebuilder will change the diaphragm spring, and also check valves and pump arm, if worn.

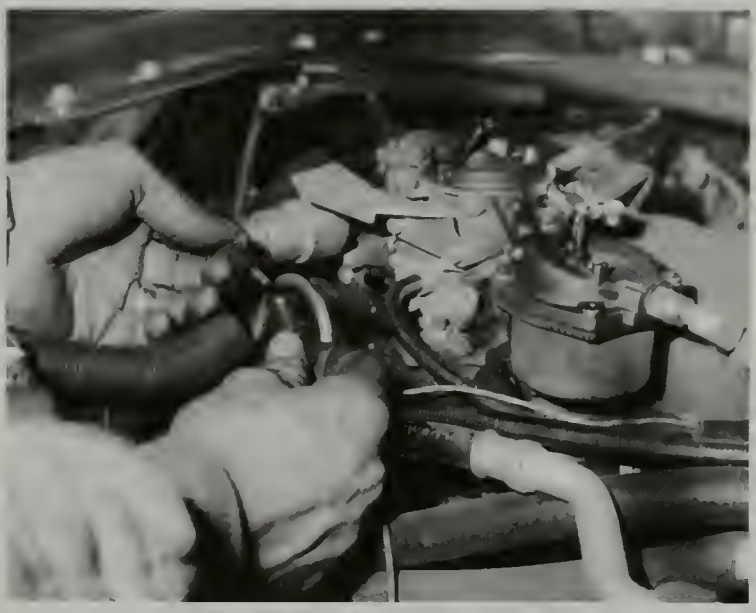
How can you be assured of a quality rebuilt? The answer is to buy from the auto parts houses that the professionals patron-

ize, and not from the stores that also sell toys and garden hoses.

Carburetor replacement. One of the most frequent troublemakers is the carburetor. Remove the air cleaner and disconnect the throttle, choke linkage and the fuel line from the fuel pump. Two to four studs hold the carburetor body to the flange. Buy an exchange carburetor to fit your car from your rebuilt parts dealer. The carburetor represents a real savings. A new four-barrel carburetor costs around $75 to $110, while the price of a rebuilt is perhaps half that, including the trade-in of your old carburetor.

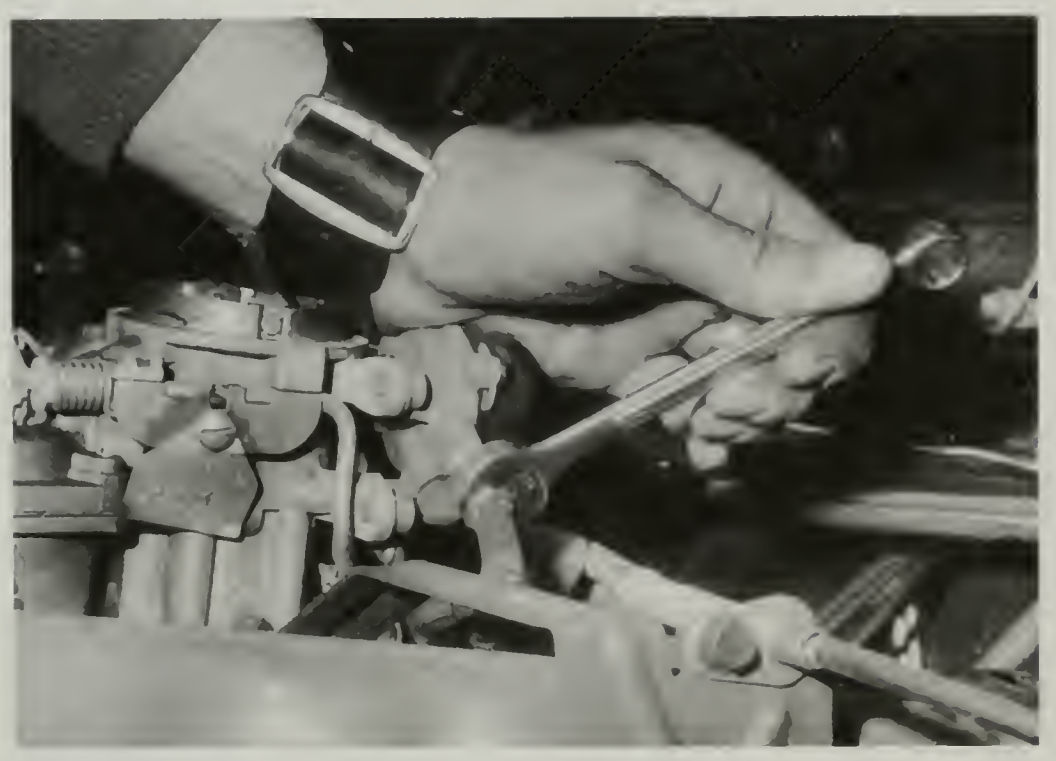
The new carburetor, depending on the rebuilder, will often require transfer of some pieces of linkage from the old carburetor to the new. So before you hand in your old carburetor, place it side by side with the new and determine what parts must be transferred.

Installing a rebuilt carburetor is the reverse of pulling the old one, although it is



Most late-model cars have an electric solenoid to regulate the precise position of the throttle. Solenoid holds throttle open slightly for idling and when engine is shut off, allows it to close completely so engine does not run on. Disconnect solenoid wire.

If new carburetor does not come with throttle solenoid, remove old one for transfer.



▲ *Disconnect automatic choke heat tube on carbs with incarburetor coil. On carbs with well choke, disconnect link from coil to choke plate.*

good practice to install a new gasket between the carburetor and the intake manifold.

To get a precise adjustment, you can use a vacuum gauge. Turn out the mixture screw or the two screws, in the case of a two- or four-barrel carb, until the engine idles smoothly without rolling or galloping. The indicator on the vacuum gauge should remain stationary, but if it oscillates in a slow floating motion, keep adjusting the idle-speed screw along with the idle-mixture screws until the gauge shows the highest vacuum without vibration. Then adjust the idle-speed screw alone for the best idle speed before the engine warms up thoroughly. On cars with automatic transmissions, it may be necessary to readjust the idle speed somewhat lower if the car tends to creep too much at a traffic light.

If the engine will not start after installation of the rebuilt distributor (and it was running, even poorly, before), chances are you have installed the distributor incorrectly and ignition timing is far off.

Many distributors will go in only one way, but many more will go in any number of ways, but the timing will be wrong and the car won't start.

The best procedure is to prevent an error by carefully marking the distributor body and the engine adjacent, and noting the position of the rotor.

If you have made an error, here is a procedure to get the engine timed close enough to get it started, after which you can use a power timing light to set timing accurately.

With the distributor removed, crank the engine in very short bursts until the timing mark on the crankshaft pulley or damper is lined up with the timing indicator on the front of the engine.

At this point, the ignition system should be ready to fire either No. 1 cylinder or its companion, No. 6 (on a six-cylinder or V-8 engine). On a four-cylinder engine with a firing order of 1-3-4-2 or 1-2-4-3, the companions are 1 and 4. On a four-cylinder with a firing order of 1-4-3-2, the companions are 1 and 3. Note: except for in-line engines, which are numbered front-to-rear, car manufacturers number the cylinders differently, and you will have to learn which is which by checking a general repair manual.

Put the distributor partly back in, lining up the body as close as you can remember to its original position. The location of the vacuum hose or tube to the distributor vacuum advance may assist your memory.

Swing the distributor cap back into position, but do not fasten it down. Just note the location of the No. 1 and No. 6 spark plug wires and aim the tip of the rotor for either of them. With the rotor so aimed, slip the distributor back in all the way. (This may take time on such as Ford products, where the distributor shaft must engage both a gear and a hex fitting.)

Refit the distributor cap and try to start the engine. If the engine seems to be trying to start, move the distributor body in short arcs, and if the engine starts, you are now ready for precise timing with the power timing light.

If it shows no sign of starting, take out the distributor and re-install, aiming the tip of the rotor for the other cylinder. Refit the distributor cap and again try to start the engine, also moving the distributor body in short arcs if the engine seems to be trying to start.

If the term "trying to start" is unfamiliar, here is what is means: the engine will fire then die immediately. This is an indication that ignition timing is close, but not close enough.

Special technique. Here is a technique that you can use to determine which cylinder (No. 1 or No. 6) is ready to fire when the timing marks are lined up. It eliminates the 50-50 odds you face otherwise.

Remove the No. 1 cylinder spark plug and watch the timing mark on the crankshaft pulley or damper. When it is several inches from the timing indicator on the engine, insert a compression gauge into the No. 1 spark plug hole and continue cranking until the marks are very close. Remove the compression gauge and see if there is a reading on it. (It won't be a normal one, but it should be something if No. 1 piston is coming up on compression.)

If there is no reading, No. 1 piston is coming up on exhaust and No. 6 is coming up on compression. The rotor tip should be pointed toward No. 6.

Generator and voltage regulator. The generator (whether an older DC type or the newer alternator) can be confidently replaced with a rebuilt, at a saving that could exceed 60 percent over a new unit.

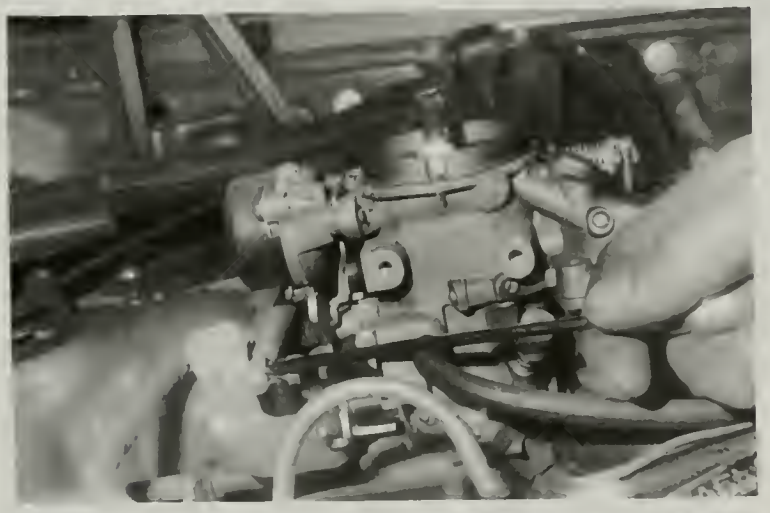
The voltage regulator is integral with the alternator on many new cars, but it is a separate unit on most others, and has always been a separate unit with DC generators.

Never install a rebuilt conventional voltage regulator. There are many reasons a voltage regulator can fail, and the rebuilding jobs are limited to replacement of the vibrating contacts.

Fully-electronic regulators have no moving parts and seldom fail. Rebuilt units of these are not readily available, although they should soon be, and will be worth considering. Note: some alternators have the regulator built in. When this type is remanufactured, a new or rebuilt regulator is included as part of the overhaul process, when necessary.

It is important that you definitely determine that the trouble is in the generator before you replace it. Broken connections, a faulty regulator and a slipping fan belt are far more likely problems.

Disconnect fuel line from carburetor.



Disconnect throttle linkage. The arrangement from one carburetor to another varies, so you will just have to see what is used. On this particular carb, pushing off a spring clip does the job.

Disconnect vacuum hoses to the carburetor.

Replacing a generator is a very straightforward job, but there is one precaution: always disconnect the battery ground cable before you start.

Two or three bolts and nuts will hold the generator, and there are two or three electrical connections. If the terminals are not sufficiently different, make a sketch showing where each wire goes before you remove anything.

Fuel pump. When a fuel pump fails, replacing it with a rebuilt is a simple job.

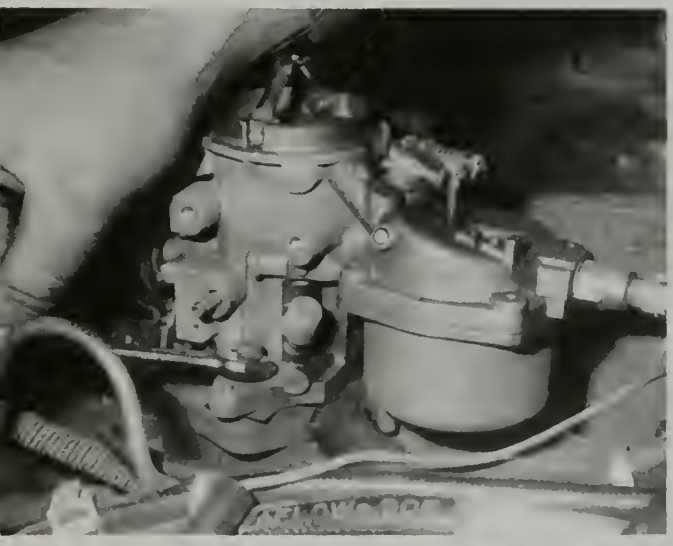
The typical fuel pump is a mechanical unit, driven by the engine. The only exceptions are some foreign cars and the Chevrolet Vega, which have electric pumps.

Tht mechanical pump is held by two bolts or studs and nuts. To replace the pump, just undo the two fuel line connections (one inlet line from the gas tank, the other an outlet line to the carburetor).

Then remove the two bolts or nuts and pull the pump straight out. On cars with a flexible hose or hoses, it may be easier to take out the bolts or nuts first and lift the pump to a position where the hose connection is easier to get at.

Warning: on Chevrolet engines, the fuel pump arm is moved by a cylinder that is in contact with the camshaft. This design can make it difficult to install a replacement pump. There are special tools available to hold the cylinder up and in its bore, so that the replacement pump can be fitted. If you don't have this tool, you can do the job with a piece of stiff wire and patience.

Virtually all Ford products have sealed



Undo the nuts or bolts that hold the carburetor to its base, and remove.

The carb is ready for removal. Just lift it up and out. Installation is a reversal of the removal procedure.

pumps, so they cannot be rebuilt except at a factory. Even if your pump is rebuildable, the low price of a factory rebuilt makes it the best choice for time-saving repair.

On Chevrolet Vega, the only American car with an electric pump, the pump is in the gas tank, which is held by two straps. To get at this pump, undo the strap nuts at the rear of the tank, lower the tank and remove the pump from its bracket.

Engine. When the engine in your car is so badly worn that it needs a complete overhaul, such as reboring, new pistons and rings, engine bearings, crankshaft regrinding, valve job, ring gear on the flywheel, etc., a rebuilt or used engine is the best answer.

You can save at least $200 by buying a rebuilt instead of a new engine, even if you could get a new engine. The rebuilding art is so highly developed in the engine field that few car makers even supply complete new engines. In many cases, all they supply are short blocks, which are engine blocks with crankshaft, connecting rods, pistons and rings. To get a complete engine, you have to buy all the accessories and cylinder heads.

Even if the car maker lists a complete engine, it will not be easy to get. The few that are made are for warranty use.

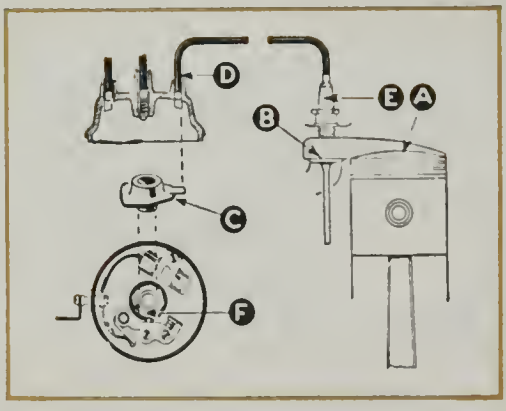
So your choice is either a factory rebuilt, a semi-custom rebuilt or a used engine from a wrecking yard.

If you can obtain a late-model used engine from a wrecking yard, this is the most economical choice. There is very little risk if you buy from a reputable wrecking yard, for it surely will have run the engine before it was pulled from the chassis, and therefore will not sell it if it burns oil or has piston slaps or bearing knocks. It also will advise you of the mileage on the engine.

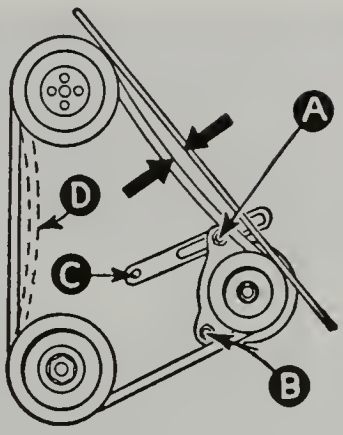
The rebuilt engine offers a bit more security, for it comes with a firm guarantee. In the rebuilt area, there are two choices:

1. The factory rebuilt. This is an engine

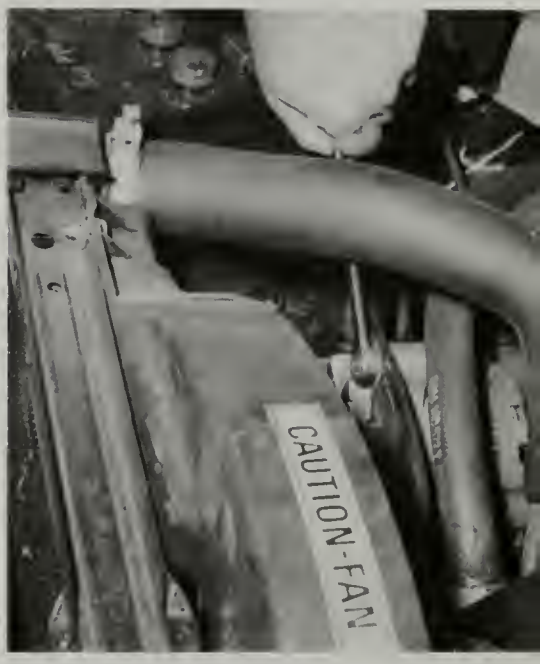
Replacement of a regulator is simple. Regulator is held by two or four screws. Hold replacement regulator next to defective unit and transfer one wire at a time.



If you make a mistake while replacing a distributor, drawing shows how to set up ignition timing close enough to get engine started, at which point timing light can be connected. Piston (A) of No. 1 cylinder is at top dead center of cylinder on compression stroke. Rotor (C) points to No. 1 spark plug wire in distributor cap (D). Lobe on cam (F) is about to open breaker points. E is the No. 1 spark plug about to fire. Intake valve (B) should be closed.



Replacement of a generator is difficult only if the generator is inaccessible. Normally it is held by two or three bolts and is removed by taking out bolts A and B, pushing generator in along pivot C, and removing belt D. There are two or three electrical connections on the generator and if they look the same, make a sketch and tag them so you can refit them correctly.



that went down an assembly line much like the one that put it together.

2. The semi-custom rebuilt. This is an engine that was rebuilt in a smaller shop with a lot more human inspections. It is 10 to 20 percent more than a factory rebuilt.

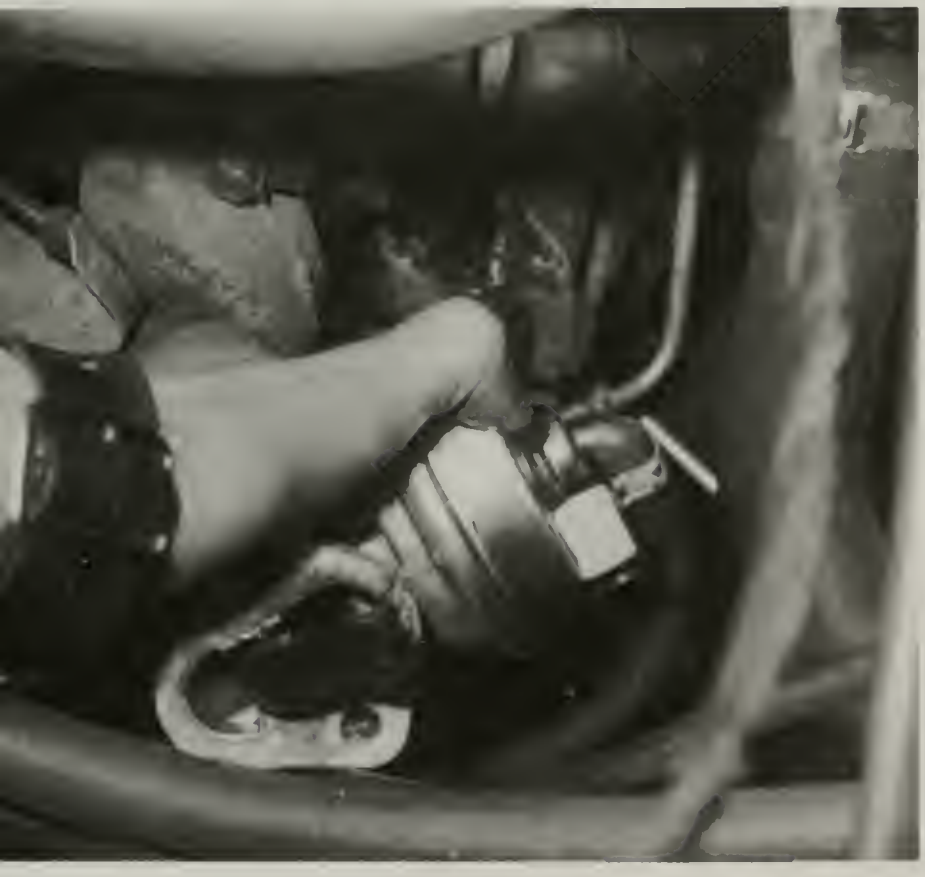
If you have an older car, or one that just wasn't a big seller, the factory rebuilt engine may not be readily available. The semi-custom rebuilding job will be done on your engine, and your car may be out of action less than a week.

Engine removal. There are no complete sets of hard-and-fast rules that will cover engine removal on all cars. Some general information, however, may help you:

1. You will need a chain or cable hoist,

Replacing fuel pump is normally not difficult if the pump bolts are accessible, and they usually are with ordinary tools. First step is to disconnect the fuel lines. In the case of this pump, only one line has to be disconnected, as other is a hose which can be swung up with the pump and removed from the top of the engine compartment more easily.

➤ *Socket wrench makes short work of the two fuel pump bolts.*



➤ *Pump can now be lifted up and hose connection taken off. This particular pump is from a Chevrolet, and a special tool is very helpful in refitting the pump so that the pump arm will properly be under an actuating cylinder.*

Chevrolet Vega has an electric fuel pump in the gas tank. When pump goes bad, you undo two strap nuts shown, drop tank and discard pump which is sealed unit.

and this can be rented for a day for a few dollars.

2. You will need something from which to hang the hoist. A heavy beam across the top of your garage or a sturdy basketball backboard normally are acceptable.

3. When you make disconnections of either tubing or wiring, tag everything so you'll know where it goes when the replacement engine is ready for installation.

4. The engine on all front-engine-rear-drive cars comes out from the top of the engine compartment, so the hood may have to be removed. Inasmuch as hood re-installation and alignment is a time-consuming procedure, you may be able to reduce it by scribing around the bolts or nuts in elongated adjustment holes with a sharp instrument.

5. Do not try to do this job without a complete set of wrenches. You will need a complete socket set (preferably both ½-inch and ⅜-inch drive), in addition to open-end and box wrenches.

6. If the car is a manual transmission, you will have to align the clutch. Inexpensive but satisfactory wooden alignment tools are available. Don't waste your money on the expensive professional-type alignment tools.

7. Although engine removal is often a one-man job, installation is never so. Have a husky friend lined up for the day you install the replacement engine. Better still, have two husky friends.

8. Keep related parts and nuts and bolts together, using envelopes appropriately marked or muffin tins. It is very easy to become impatient when pulling an engine, and just pile up nuts and bolts. But when the job of installation comes later, one misplaced nut or bolt could hold you up for an hour or more.

9. Rebuilt engines are supplied stripped of accessories, but including all innards. It's best to equip the rebuilt block with rebuilt carburetor, distributor, fuel pump, generator and other parts subject to wear.

10. If you can, obtain a factory shop manual. It won't make the job that much easier, but it may keep you from breaking something.

11. If the engine seems to be stuck, either coming out or going in, look for a reason instead of applying heavy force. And be very careful not to pinch tubing or lines.

12. On virtually every engine pull, you will have to do the following:

a. drain engine oil and cooling system; disconnect hoses.

b. disconnect ignition system at the coil's "SW" or plus terminal.

c. disconnect the fuel system from the tank. Because of clearance problems, you may also have to pull the fuel pump and carburetor.

d. disconnect the exhaust pipe from the exhaust manifold, and if clearance is limited, remove the exhaust manifold.

e. disconnect the electrical ground strap from the chassis to the engine. On late-model cars, a split ground strap is sometimes used, with one part going from battery to chassis, the other part from battery to engine. If your car doesn't have this, look for a separate strap from engine to chassis. It may be buried underneath, and would, if

left connected, keep the engine from coming out.

f. disconnect the engine mounts. Most cars have two (there is a third support at the transmission).

13. If the engine compartment looks a bit crowded, remove any accessories that are reasonably easy to get at, such as alternator, oil filter, possibly the starter.

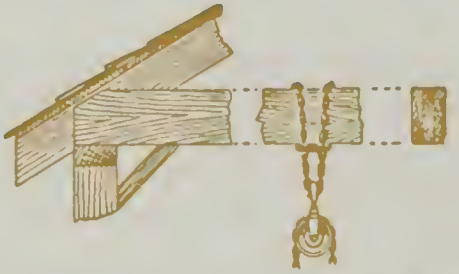
14. The last item on this list should actually be the first on yours: always disconnect the battery cables before you start working. In fact, removing the battery and both cables will not only give you more room, but in part is necessary for engine removal (the cable to the starter has to come out).

With the engine out, clean the compartment of all grease and mud with a putty knife and rags soaked in solvent. Examine the rubber engine mounts and replace them if they are flattened, broken or uneven. It it inexpensive insurance to replace the mounts, as they will have become worn by the time the engine needs replacing.

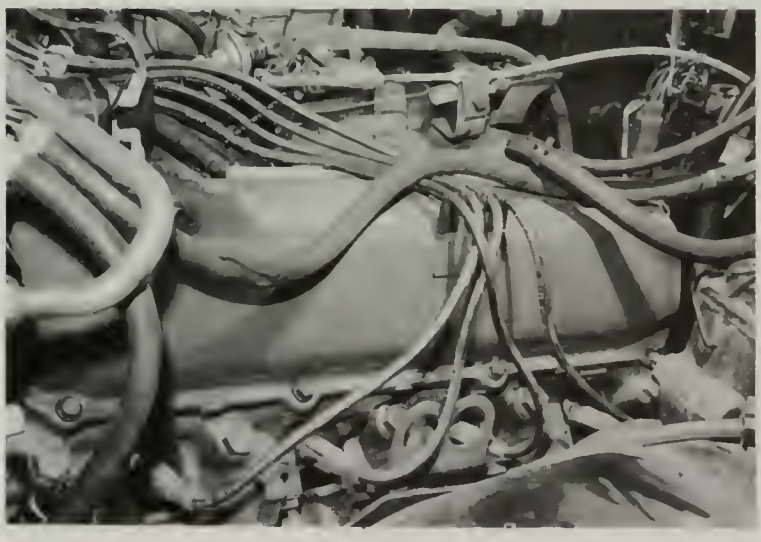
Once you install your practically new engine, use a new fan belt, ignition wiring, battery cables and hose connections to complete the installation. Install new spark plugs of proper heat range and gapped for your engine. (Check with your service station to determine the correct gap for your engine. Most older cars use a .025 inch plug gap; all recent cars use a gap of .035, and most plugs manufactured today are sold with the wider gap.)

Installing replacement parts is not limited to engine parts. Replacement transmissions, universal joints, muffler and exhaust pipes, brakes, front suspension parts and shock absorbers are available. Some are rebuilt, some new. P.W.

See also: AIR CLEANERS; ANTI-POLLUTION; COOLING SYSTEMS, AUTO; DC GENERATOR, AUTO; ENGINE; HAND TOOLS; IGNITION SYSTEM, AUTO; OIL, ENGINE; SHOCK ABSORBERS, AUTO; TUNE-UP, ENGINE; VACUUM GAUGE; INDIVIDUAL PARTS LISTINGS.



▲ *Chain sling over built-up beam across caps of garage walls supports chain hoist to lift out engine.*



◀ *Many engines have lifting hooks, which makes the job of removing them a bit easier. There are two on this V-8, one on each side between second and third spark plugs.*

How to Patch Plaster Walls

Plastering a whole wall is a job for a professional, but any householder can make repairs, from hairline cracks to fairly large sections

PLASTERING AN EXTRA ROOM added onto the house, or an extensive remodeling job, is something few non-professionals will master, but the same cannot be said of plaster patching. Repair of plastered walls requires few tools: a trowel, putty knife, water brush, bucket, chisel, sanding block and drop cloth. The methods are so standard that it's hard to imagine anyone having difficulty if he follows directions.

Few people appreciate the inherent quality of a plastered home. Most ordinary plaster cracks are only surface deep and pose about as much threat to your home as a scratched fender is to your car. A crack is unsightly and it collects dust, but beyond that it's no cause for worry. Plastered walls are seamless. There are no nails to pop out, no paper surfaces to deteriorate and no joints to pull apart with age. It's fireproof to an amazing degree, and it's a durable wall that you aren't likely to penetrate with a bump of your elbow.

The important point is that plastered walls are well worth repairing, and even a battle-scarred home 30 years old can be made to look like new after a couple of hours of patching. Rest assured that a few cracks, and perhaps a hole here and there, have little (if any) effect on the total strength of your plastered walls.

The right materials. You can avoid a great deal of trouble right at the outset by ignoring special "blends" or "additives" that can be mixed with plaster to make it set slower or faster. These are handy devices for the professional who has the experience to use them to advantage, but gen-

paths and walks: see brickwork
patio deck: see decks
patio design: see patios
patio flower wagon: see wagon
patio rocker: see furniture, outdoor

erally the handyman will only be confused, delayed, excited and angered if he tries to whip up complicated concoctions.

Just about any building supply store carries plaster materials. In large cities, you may find a specialized plaster building supply store, which is the best place to obtain patching products. Here are the patching materials to use for the basic plaster problems.

For surface cracks, commercially packaged patching plasters work best. Sometimes the buyer has a choice of slow-set or fast-set products. The inexperienced user will do best with slow-set materials. The fast-set label means just that, and such a product may become hard in less than three minutes after mixing. This is not enough time for the amateur to mix, fill and smooth the repair.

Professional plasterers use ordinary casting plaster for patching duty. This material is packaged, with very slight differences, for sale in drug stores under the name of Plaster of Paris. The price in a plaster supply house is a few cents a pound. At the drug store, the price may be from 10 to 30 cents per pound. This comparison obviously indicates that plaster repair materials should be purchased at the right source: the supply house.

All pre-mixed packaged patch materials need only water to make them effective and ready for use. So why get involved in additives or use secret formulas?

Light surface cracks, screw and nail holes, dents in the wall, holes where pipes have been removed and areas that have succumbed to dry rot are all easily repaired with ordinary patching plasters.

Extensive repairs. Wall openings more than a few inches in diameter should be filled with gypsum-base plaster. The materials for this are more adaptable and less expensive than patching plasters, more elastic and easier to handle, and slower setting for better workability. Use gypsum-base (or fibered) plaster when covering areas where windows or heaters, etc., have been removed for filling large areas that

Use a beer can opener to widen cracks for patching. Undercutting the edges is unnecessary. After the crack is widened and all loose plaster brushed out, wet the crack before filling it with plaster.

have been afflicted with dry rot and for filling areas where the plaster has been knocked out down to the exposed lath (lath is the material—wood, metal or gypsum board—on which plaster is applied).

Ratios for mixing gypsum plaster vary from about 10 to 20 shovelfuls of sand per 100-lb. sack, according to the directions of the manufacturer, so be sure to read these directions on the bag when buying gypsum plasters. For mixing smaller amounts, figure it percentage-wise.

Lime-base finish plasters are necessary only when very large areas (say, over 2 feet square) are covered. In such cases, purchase colored interior stucco. This material is spread over the gypsum base-coat which has filled and leveled the surface, and been fully cured. It is not an expensive material, and it is easy to handle if you spread it with a plasterer's trowel.

If the repair will be covered with wallpaper or wood paneling, there is no need for this finish coat of interior stucco. The application of gypsum plaster alone is then sufficient. The finish coat merely gives a smoother appearance.

Patching methods. Cracks in plaster should be opened slightly so that a sufficient amount of patching plaster can be forced in. In the opinion of most professional plasterers, undercutting a surface crack is not necessary. The cracks are so tiny to start with and the repair so simple to handle that it's simply wasted motion to meticulously go down the length of a long crack, tediously digging away under every edge. The theory has been that undercutting allows a stronger bond of the patch to the original material and that undercutting the edges tends to seal in the filler agent. Actually, undercutting a crack often weakens the edges severely (the spot where most strength is needed!) and thus leads to future problems.

The easiest way to open the crack is with a beer can opener held at an angle to the crack. Run the opener vigorously down the crack, making sure that loose particles are brushed out. (You may also use a chisel or a screwdriver.)

Far more important to a good bond than anything else is getting a firm surface-edge and wetting it carefully before repair. Patching plaster does not adhere well to dry surfaces. It is best to wet it with a saturated brush run through the crack. On larger patches, wet the edges all around,

Force plaster into the crack with a putty knife.

then immediately proceed with the filling operation.

Mixing materials. Add water to the plaster in small amounts—don't fill a bucket with water and pour in the plaster. Adding water to the plaster allows the user to get the consistency he desires. The ideal mix is about as viscous as cooked oatmeal. Too thin, and it will slide out of the repair. Too thick, and it will prematurely harden and be difficult to spread.

Use a flat board about 12 inches square to carry small amounts of patching plaster from room to room. Keep a bucket of water handy for softening the plaster when it gets too hard.

Filling cracks. With the crack widened and edges wetted as previously described, force in your patching plaster the full length of the crack, making no attempt to level the surface; overfill the crack slightly. After filling, wet the edge of your putty knife and run it with the flat side of the blade over the top of the crack. This removes excess material. Allow the patch to dry hard, then sand it smooth. That's all there is to it.

Ceiling patches. Pull away loose finish plaster until a firm surface is encountered, mix patching plaster and wet the surface. Apply plaster in thin layers until the right depth is achieved; then run a wet trowel repeatedly over the repair. The more you trowel it, the smoother it will get. This technique can be used on any interior patch with a diameter of less than about 12 inches.

Large repairs. As suggested, use gypsum plaster to fill large wall areas. Some method must be found to level the surface, since the area may be wider than the trowel used to spread the material. Any straight, smooth board can be utilized. Let each end of the board ride firmly on the adjacent walls while you "saw" the board back and forth up the wall, carving off excess plaster. If depressions remain in the surface, spread more gypsum plaster over the low areas and board it off again. Repeat this process until the surface is true and flush with the original wall.

▲ *Use a putty knife to fill small holes.*

You can smooth gypsum plaster while it is still soft by sprinkling the surface lightly with water and running a trowel, held nearly flat, over it. Keep the trowel clean and wet while slicking the surface. Plasterers use a "darby" but, unless the area being repaired is quite large, avoid it —it only leads to difficulty for the novice. But almost anyone can handle a trowel.

Wallpaper or wood paneling can be applied right over the gypsum basecoat after it has cured hard (a matter of days). If the surface is to be painted, apply a finish coat of interior stucco over the gypsum plaster after it has hardened. This is applied with overlapping strokes in a thin ⅛-inch layer and troweled smooth with a wet brush and trowel.

See also: PAINTING; PAINTING, HOUSE.

How to Repair Holes in Wallboard

Plasterboard has no lath to provide a backing for the patch, but you can use this trick to provide one

UNLIKE A PLASTER WALL which has a base of wire, wood or gypsum lath under the plaster, plasterboard stands alone, which poses a problem. Some backing material must be found before patching plaster can be used to fill the gap.

The accompanying photos show how easy it is to attach a length of wire to a piece of screen mesh, force it through the hole in the wall to provide a solid backing for the patching substance. Hardware stores and building supply houses carry several brands of patch plaster for this duty. Avoid wetting the adjacent plasterboard walls any more than necessary. They have a paper surface which is easily scarred. For this reason, a final coat of shellac over the hardened patch is recommended as a basecoat for finish paint. Holes up to three or four inches in diameter can be repaired in this way. If the work is done correctly, no visible spot will reveal the presence of the patch.

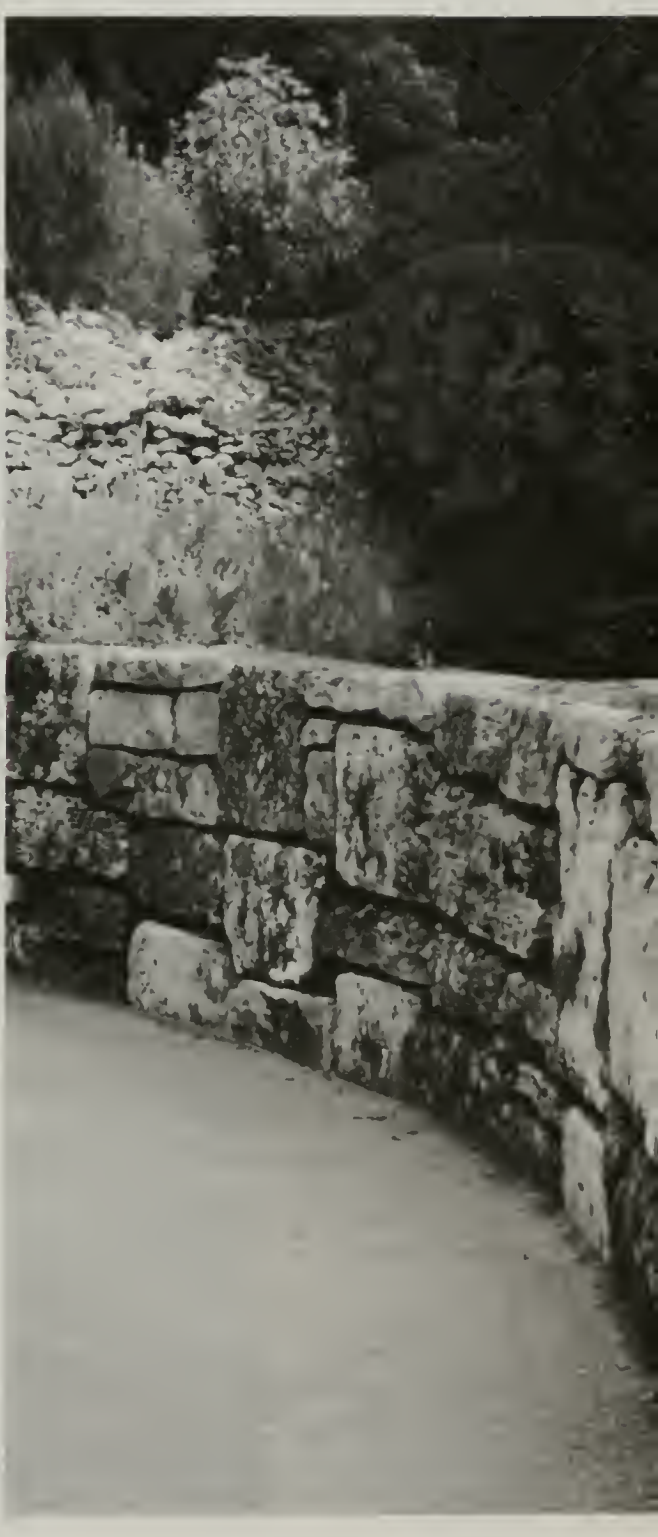
See also: PAINTING; PAINTING, HOUSE; WALLBOARD; WALL COVERINGS.

▲ *To fill a hole in plasterboard, first cut a piece of wire mesh slightly larger than the hole, tie a piece of wire to it and force it into the hole. Then bend the wire around a nail or larger stiff piece of wire to hold the mesh in place.*

▼ *Apply spackling compound to the hole, using the wire mesh as a support behind the patch. When the patch is hard, snip off the end of the wire. The buried mesh and wire stay in place. The exposed wire is removed. After the wire is removed, sand the patch flush with the wall, but do it gently. Pressing too hard will form a depression in the patch.*

The Basics of Patio Design

When you remove the furnishings and greenery you are left with some basic shapes. This is where your planning should begin



PATIOS AND TERRACES, although a central part of the overall landscape, should be designed primarily for privacy, comfort and recreation. The usual aim is to create a livable outdoor area closely related to the house. Taking this into consideration, the best patios and terraces are usually in scale with the lot and house in relation to their intended recreational use. Keep in mind, while thinking about possible uses for such an area, that your final decision, although intended to serve certain recreation purposes, will hinge primarily on two factors relating to that use: a basic design and its relation to the sun.

Basic designs. Remember that your patio or terrace design will belong to the landscape as a whole. There are three basic designs to work with, but their concepts can easily be mixed or married in any way that seems relevant to your particular needs. As you study the description of each design, try to mentally picture it as part of your lanscape.

Rectangular designs are seldom wrong.

patio screens: see breezeways
patio table: see furniture, outdoor

The form is easily related to the house and property lines, and can be set at right angles to them. An acute angle is still considered "modern" in many circles, but when space is at a premium a patio set at a 45° slant seems to create a feeling of greater space.

Freeform shapes are in vogue because they are flexible and adaptable. When the size is in proportion to the house and when lines relate to its shape, the forms are exciting. As you plan unconventional shapes begin with a rectangle then soften edges and proportions until the results seem pleasing. Avoid sharp corners (or too many of them) and never pinch lines, that is narrow areas until the form seems unstable.

Circular designs are not as common, but can relate well in larger areas. Often circles are used within rectangles and freeforms to accent. In many cases the area is decorated with a different paving, texture or material.

Terrace is ideal for adults and children. Mother can relax on sunbathing deck while kids play in sandbox.

Spanish theme in sun deck and adobe wall used in this patio tie it into overall architectural scheme while creating much needed shade at the same time.

The Basics of Patio Design

Try all designs on paper first. What looked good in your mental picture may appear differently on paper. After you've narrowed your choice down, you can actually test its feasibility in your yard. Forms can be traced full-size with a garden hose. Then stand back a distance and see it in relation to the size of your house. Remember, you're trying to create a livable outdoor area closely related to the house. When you are in doubt, consult a qualified landscape architect. His advice and planning may cost from $100 to $1000, but the money is well spent. Professional advice eliminates errors and saves both time and money.

Relation to the sun. It should be obvious by now that you probably will not be able to create a recreational area that has the maximum amount of privacy and comfort that you would like to have. As you plan, you will find yourself having to sacrifice

➤ *Window wall and extended beams ease transition from interior to patio. Patio furniture follows clean lines of house.*

➤ *Patio here is example of freeform shape. Problem of choosing between sun or shade is settled by having pagoda roof shade one bench, other bench is in the open.*

Where the number of sunny days is limited, look southward to create areas to trap sun.

This patio uses slatted wall to break up hot evening rays of sun, while allowing cool breezes to enter.

one for the other in many instances. If you want to stress sunny areas or perhaps play them down for more cooling shade, you are going to find yourself hindered by conditions far beyond your control—the natural geography of your lot and the surrounding neighborhood. You must decide what you want and how best to get those conditions.

Look to the south and southwest for warmth and let walls reflect sunlight onto needed areas. When the sun is plentiful, do just the opposite, creating a series of areas to trap the shade. Look to the north and northwest to help in this.

Sun-oriented areas face south or west and are recommended for regions where the sun's rays are welcome year around. A southern exposure invites a full day's sun, dries quickly after rains and warms quickly on winter days. A western-facing area offers greater contrast, cool mornings and warm afternoons. Neither location is suggested for the hotter sections of our country. There, sun-oriented patios generally require extensive shade, cooling and screening to withhold the slanting rays of the late evening sun. Shade-oriented patios face north or east and are best in the warmer states. They are cool and restful. A northern exposure is coolest and sections of a patio facing that direction may never see the sun. An eastern orientation welcomes the cooler morning sun and protects against the hot evening rays. Note carefully the house and its relation to the entrance drive and walks. Consider sites for a private terrace, service facilities and a sunny section for gardening.

After you have decided on a basic design and its orientation in relation to the sun, you must finally take into account the appearance of the property from the street. Don't forget your original aim was to create an area for privacy, comfort and recreation that is tied in to the size of the house and lot while being a central part of the overall landscape.

See also: BREEZEWAYS; BRICKWORK; CONCRETE BLOCKS; DECKS; GARDEN PLANNING; LANDSCAPING; LIGHTING; MASONRY; PANELS.

How to Build a Patio Screen

The curved sweep of this patio screen, and the use of planter openings to relieve the repetition of vertical lines, make it attractive to view from either side

A MODERN SCREEN that appears to be a natural part of your landscape will unify house and patio, provide for your outdoor living and entertainment, and add to the value of your home.

The screen shown here has a slight curve to match the contour of the patio and give it a three-dimensional appearance. A 26-foot-long seat was built to accommodate guests and is wide enough for sunbathing.

Redwood was used in construction because of its outdoor qualities. Other materials, however, can be used. Even exterior plywood would be appropriate. If the wood you select is not naturally resistant to insects, rot, and decay (this applies only to those areas of the posts below grade), brush on or soak it in a preservative.

First step is to mark the centerline of the posts on a line duplicating the contour of the patio. Best way to do this is to make a scribe by driving a nail through one end of a 1 x 2 x 24-inch furring strip. Butt one end of the 1 x 2 against the patio edge, and move the marker along so the nail makes a groove in the ground to mark the post centerline.

If the patio is curved, the inside face of the posts must be parallel to the tangent of that curve, so the distance between posts will vary slightly. This doesn't apply if the screen is straight. Mark post locations on the line and dig the post holes with an auger or post hole digger at least 6 inches in diameter. Holes should be 24 inches deep for the screen posts, and 12 inches deep for the posts that support the seat.

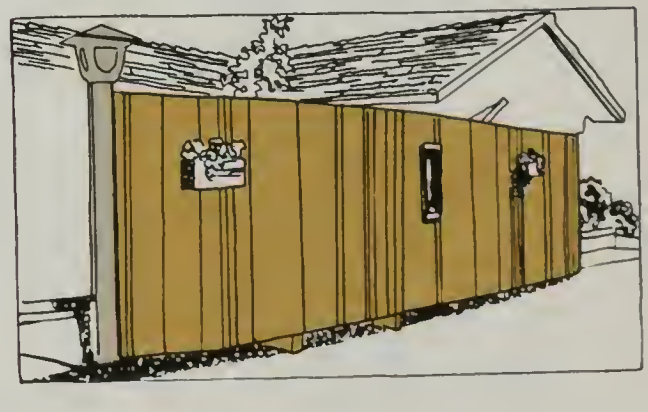
Posts in the drawing were set on 4-foot centers to match the spacing of headers in the concrete patio and were needed to provide adequate support for the 26-foot-long seat. If you plan to build the screen without the seat, put the posts 6- to 8-feet on center.

Cut both screen and seat posts to approximate length and place them in the holes. Use a carpenter's level to mark the patio level on the posts. All vertical measurements above grade will be made from these marks.

Cut the seat headers to exact length and mark the dados needed in the headers and posts. You can form these dados by making outline cuts with a hand saw, then chiseling away the waste. To make these dados on the average home workshop table saw or radial arm saw, you'll need an 8-inch dado assembly.

Make sub-assemblies of the posts and header combinations. If you plan to install an outdoor light at one end of the screen, you'll have to plan for the cord hole before

Attractive from both sides, this rustic privacy screen uses figure and planter openings to break up the wide expanse of wood sheathing.



assembling the end post. To make provisions for the cord, cut a deep dado along the length of the post, then close it partially with a filler strip. Be sure to snake this wire through before you set the post permanently in the ground, and remember the wire is in this post. Any nailing must be done off-center to avoid hitting the wire.

Have someone help you set the post assembly in the holes and attach temporary bracing to keep the framework plumb. First set them up by eye, driving bracing nails in just enough to hold the pieces in place. Then go over each post with a carpenter's level to be sure it is perfect. Check levelness of the seat headers as well as the vertical members.

When you are sure everything is plumb, mix a batch of concrete and fill the holes around the posts. Fill and tamp the concrete to about 1 inch below grade so soil can be used to hide the concrete. Since you won't need too much concrete for this job, buy it by the sack. Let the concrete set for at least 24 hours before working further. Sprinkle water on it daily so the concrete will cure properly for at least a week.

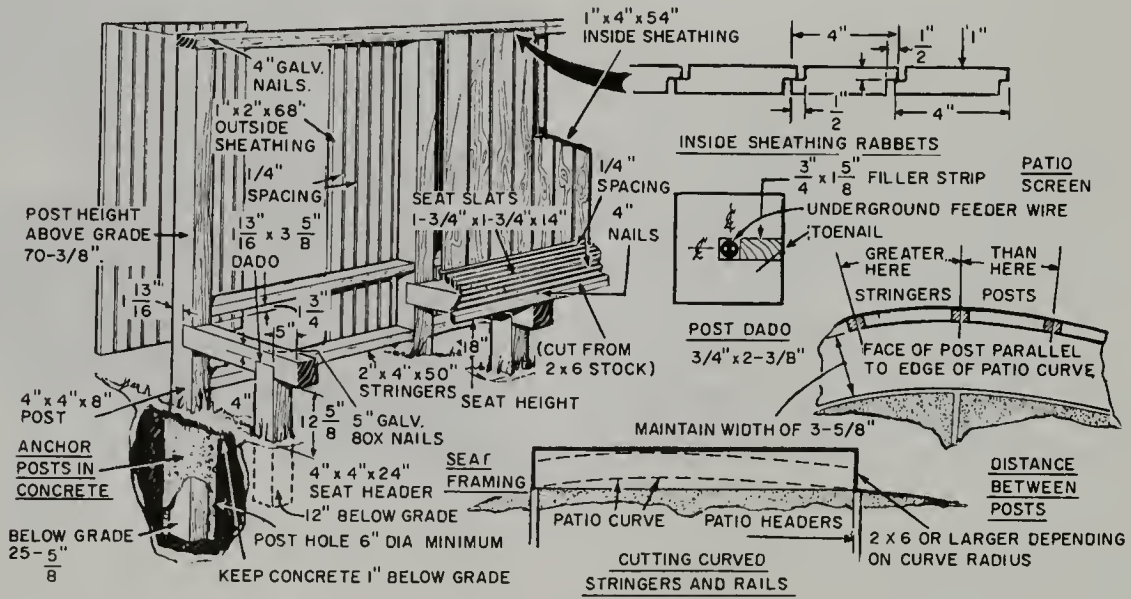
Installing the stringers is a matter of cutting them to length so they fit snugly between the posts and toenailing them in place with 4-inch galvanized box nails. If the screen is straight, you can use 2 x 4s; if not, you'll have to cut curved stringers out of 2 x 6s or 2 x 8s. Use a large piece of wrapping paper to plot the curve and transfer it to the stringer. Make the length a little over-size so you can trim to fit on assembly.

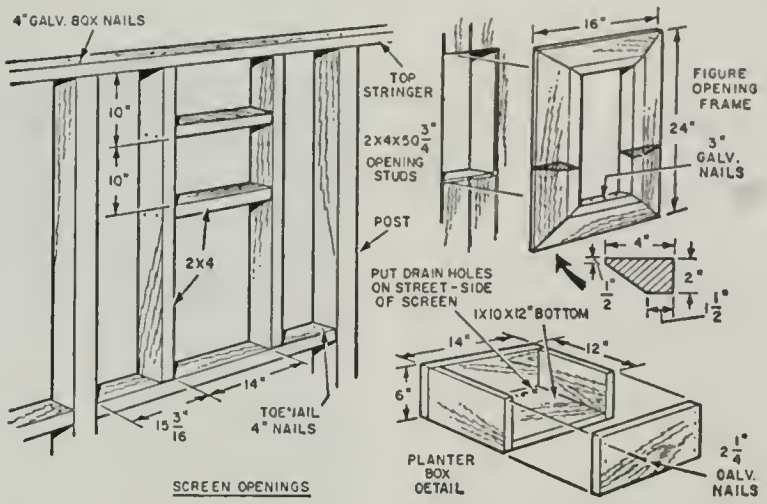
When toenailing the stringers, use temporary support blocks to hold them in place. This will help maintain alignment when you drive in the 3-inch galvanized nails.

Install the studs and headers for the screen openings. These dimensions are not critical. If you want larger or smaller openings, adjust the measurements to suit your requirements. Eliminate studs and headers if no openings are wanted.

Outside sheathing should be installed by using a level to get the first board plumb, then using a small piece of ¼-inch plywood as a spacer to install the remaining pieces. Use a chalk line to keep the bottom even, then drive 2½-inch nails into the bottom and middle stringers and top rail.

This screen was double-sheathed with different textured materials to give a contrasting appearance from outside to inside. This adds to cost, so if the outside of your screen is not too important leave it unsheathed.





SCREEN OPENINGS

It is cheaper to buy 2 x 6 construction grade redwood and cut it to 1¾-inch-square stock for the seat slats. This size will bend to fit a moderate curve. Make a U-shaped jig to straddle the seat posts to bend the slats. Drill a 3/16-inch pilot hole through the slats to prevent the wood from splitting when you drive in the 4-inch nails. To get a uniform appearance, use a ¼-inch plywood spacer between the slats. A saber saw will do a good job of rounding off the seat ends.

Inside sheathing can be bought as rough 1 x 4s in 14-foot lengths, then run over a 6-inch jointer to get a finished faceside. After the boards are cut to length, cut ½-inch rabbets and edge-mount the sheathing. Use the plywood spacer when installing the sheathing to leave enough room for the wood to contract and expand with changing climatic conditions and to give the surface a solid face with vertical shadow lines.

Final touches are the planter boxes and figure opening molding. Exterior surfaces of the boxes can be roughed up to provide a rustic texture that blends with screen.

Position the planters in the screen openings, then drill drain holes through the bottom to direct excess water on the outside part of the screen. This way, the water won't drain down on the seat.

If you want the screen to look rustic, let it weather a while before brushing on one or two coats of sealer. Or, you can stain or paint it.

See also: BREEZEWAYS; CONCRETE BLOCKS; DECKS; LANDSCAPING; PANELS.

MATERIALS LIST

Quantity	Size and Description	Purpose
135	1" 2"x6' redwood	outside sheathing
80	1" 4"x6' redwood	inside sheathing
1	1" 6"x8' redwood	planter sides
1	1" 10"x24" redwood	planter bottom
22	1¾" 1¾"x14' redwood	seat slats
1	2" 4"x4' redwood	ends and sides
9	2" 4"x10' redwood	stringers, studs and headers
2	2" 4"x14' redwood	top rails
7	4" 4"x8' redwood	posts
1	4" 4"x9' redwood	seat posts and headers
2	4" 4"x10' redwood	seat posts and headers

NOTE: Also need 2¼", 2½", 3", 3¼", 4" and 5" galvanized common nails.

Checking Your Shotgun's Pattern

Patterning itself will tell you little that you need to know, but it does serve as a check on your shooting habits, and it can reveal a bent barrel

Pattern shooting is done off-hand. Shooter cheeks gun, even at maximum point of recoil. To retain the same point of aim throughout, it is essential to mount gun same way each time.

PERIODICALLY, THE SAGES in the shooting publications advise that you should pattern your scattergun. According to the shotgun experts, this will show you the real choke that your shotgun carries, since the one indicated by the maker of the gun is an approximation, at best. Patterning is also supposed to show you why you miss birds, and will, according to these experts, also reveal to you which load and what shot size is most suitable for your gun. The patterning story is very much like so many other old wives' tales you hear about shotguns.

There is the one that says long barrels shoot harder. The fact is that a 30-inch barrel will give a shot charge just a bit more velocity than a 26- or 24-inch tube, but the bird 35 yards out won't know it, since the difference in velocity is a few feet per second at the most. Moreover, the longer barrel becomes a problem in the hunting field.

There is another story that you can use a dime to determine what kind of choke your gun carries. If a dime fits into the muzzle of your shotgun, it means only that you are the proud possessor of a dime—nothing more. Besides, not all dimes have an identical diameter.

In twin-tube guns, that is over/under or side-by-side shotguns, there is a process called regulating. That is the job of aligning both tubes so that they shoot to the same point of impact when the point of aim remains identical. This regulating is done before the barrels are soldered together. British gun makers are experts at this critical job, but the days of the barrel makers painstakingly regulating barrels are just about over. Only the British "Best Grade" and the few double rifles produced these days have their barrels regulated.

Few of the other foreign shotguns and none of the domestic guns are regulated in the old manner. Nowadays, there are precision machines that tell the gun maker if the two tubes will shoot to the same point. In doing your own patterning to see if the

pebbled stone: see brickwork
pedals: see bicycles
peeling paint: see painting, house
perch: see fishing
perennials: see garden planning

barrels are at least reasonably well aligned, you must remember that any change—either in hold, sight picture or shot charge—will affect the location of the pattern of the second barrel when you compare the two patterns.

Until a few years ago, most shotgunners assumed that if you used one brand of shells, always with the same shot size and amount of shot, that you would be getting repeatable patterns or shot performance. However, extensive tests have proved that this is not so. In-depth tests with both handloads and with factory shells under controlled laboratory conditions revealed that the smoothbore barrel is, in some respects, very much like the rifled tube—each shot and each shell gave a slightly different pattern. As a matter of fact, not even the flight patterns of the shot charges were identical—a fact that was revealed by high-speed photographs.

Patterning does have some useful purpose, but, at the very best, it has only limited application. The thin-walled tubes on shotguns are prone to suffer accidental dents. If not severe, these dents seldom affect the performance of the gun. But a surprising number of barrels are bent every year—not severely enough to make the damage readily apparent, but just enough to displace the pattern from the point of aim. Finding out that your barrel (or barrels) point high or low, to the left or right, will give you an indication that there is something wrong with your gun. Equally as important, it will also tell you that you have not suddenly lost your skill with a scattergun.

Long strings of patterning tests have shown several things. First of all, any patterning done is, at best, an average. Repeated tests with the same ammo, but from different production lots, revealed a pattern variation of up to 7 percent. Shells with identical loads, but from different manufacturers, showed pattern variations of almost 8 percent. Handloads, loaded on the same machine by the same operator, with the same amount of wad seating pressure, varied as much as 8 percent.

Patterns shot in the morning with Brand X shells varied from the patterns shot with identical Brand X shells in the evening. As a matter of fact, some rather scholarly research in England, some years ago, revealed that pattern is affected by the amount of heat built in the barrel. While this may not be of importance to the upland hunter, the trap and skeet shooter may now have a

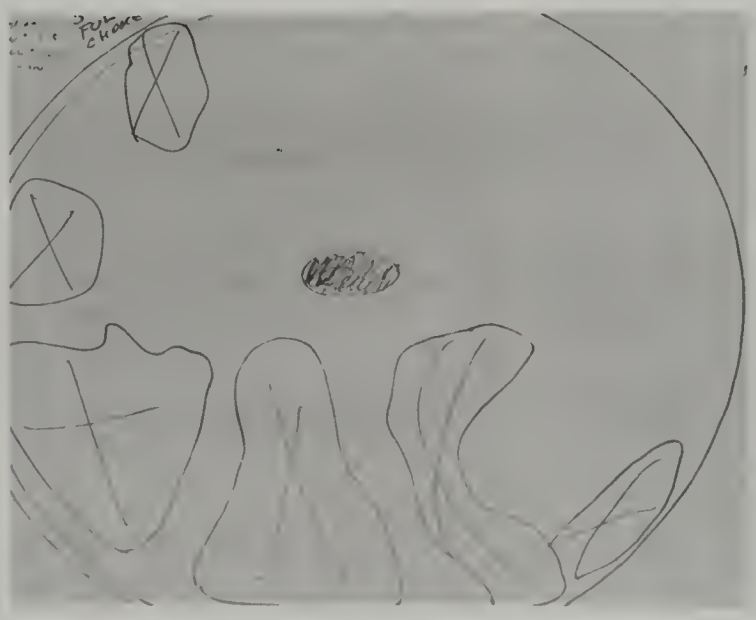
Commercial patterning targets are available, but are not essential.

brand-new excuse for missing—the barrel was overheated!

If pattern you must, here is the way to go about this chore. Find a place where you can step off 40 yards, and where you can shoot undisturbed. You'll need some patterning paper, preferably white, and no smaller than 50 x 50 inches. If you can't find paper that large, use several smaller pieces and tape them together. Staple or tape the patterning paper on plywood or cardboard—use any means you can devise to keep the paper from flapping in the breezes. If you shoot off-hand, and that is generally the best way and also the easiest, be sure that you mount the patterning paper at approximate eye level. You should have at least five sheets of patterning paper, and six will give you a slightly better picture of what the barrel of your gun is doing.

With black crayon or marking ink, make a black aiming spot in the center of each sheet of paper. Step back to the 40 yard line (skeet guns and .410s are best patterned at 25-30 yards), and fire one shotshell at the pattern paper, using the black aiming point in very much the way you would get the sight picture of a rising bird. Mark your pattern paper with the load or shell information—if handloaded, give load data, size and amount of shots, what wad was used. With factory ammo, give shot size, make and whatever other data you find on the shell box. Repeat this firing at the rest of the patterning sheets, keeping your sight picture the same each time, then carefully roll up the papers and take them home. In patterning your gun, you should also note which barrel of a double was used to fire a given pattern, and if your single barrel has a variable choke, note at which setting the device was when you fired.

The pattern papers are spread out on a large flat surface. Before you do anything, such as counting or drawing circles, look at the pattern in relation to the aiming point. Here is the first indication of whether your gun shoots near point of aim, and it soon becomes obvious why sight picture and holding is so important in the course of patterning. A gun that does not shoot to point of aim does not necessarily have a bent barrel. If you don't cheek your gun the



Check marks indicate pellet holes that have been counted. The Xs mark areas where no shot hit the paper. This supposedly full-choked barrel gave a 37 percent shot pattern.

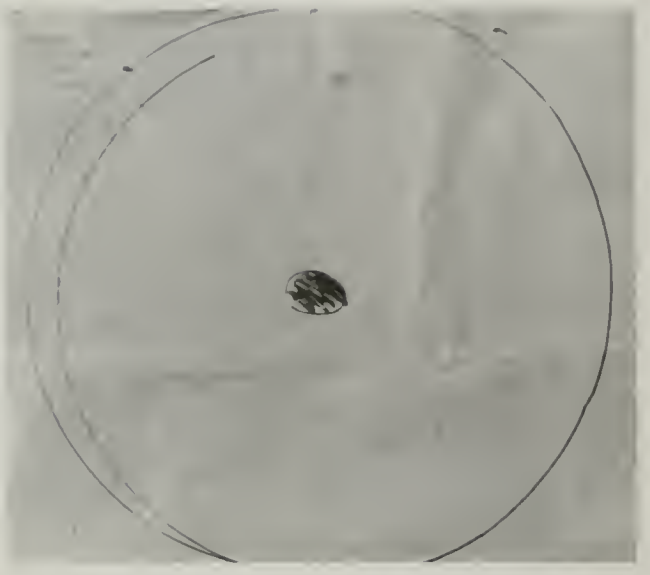
same way every time, you will not place the pattern on your target the same every time. Some shooters find that they cannot adapt themselves to the stock, and stock alterations may be in order.

With one pattern in front of you, find the approximate center of the pattern, then draw a circle with a 15-inch radius around that center. In case your geometry is a bit rusty, a 15-inch radius is the same as a 30-inch diameter. A piece of string with a nail at one end and a pencil tied to the other end will make a very efficient compass for drawing the circle.

Now look at the pattern again. How far is the center of the shot charge from the aiming point? Is the center of the pattern identical on all sheets? If the center of the shot charge is off on all patterning sheets, you know that your gun does not point where you think it does. If you have been testing a double, either stack barrel or s/s, then you'll find out if both barrels shoot to the same point of aim. Ideally, twin tubes should superimpose their patterns at 40 yards.

Now take one pattern paper at a time. Are there areas on the paper, four or five inches across, that do not show pellet holes? Such blown patterns often indicate ammo faults. Especially in handloads, blown patterns are often the reason for misses.

In determining the amount of choke your barrel actually delivers, you must count the pellet holes within each 30-inch circle. You can draw lines in the form of pie cuts, or quarter the circle, to make counting a bit easier. Count all the pellet holes that touch the circle, as well as those within it. You know, of course, how much shot and what size shot you had in each shell. Divide the total number of pellet holes in each 30-inch circle by the number of pellets in each shell. That is the pattern percentage. Average the pattern percentage from the five or six patterning papers, and the resulting figure is the average choke your gun delivered that day with that particular load.



▲ *The pattern distribution here is not what it could be. The hunter's prey could fly through several areas not covered by shot and never feel a sting.*

Keep in mind that no two manufacturers base their choke markings on the same pattern percentage. The following choke data are those most widely accepted, but remember at all times that these are averages. Full choke about 65-70 per cent of the pellets should be in the 30-inch circle; improved-modified chokes deliver about 55-65 per cent pattern density; modified chokes about 45-55 per cent; improved cylinder only about 35-45 per cent; and cylinder boring gives only 25-35 per cent pattern density. Incidentally, the choke is swaged into the last inch or two of the barrel. Hence, if you cut the muzzle end off a shotgun barrel, you also remove the choke and you will, in effect, have a cylinder bored gun.

If you want to waste more paper, and like crawling around on the floor counting pellet holes, you can repeat these pattern-

➤ *The barrel separation keeps each barrel somewhat cooler.*

ing tests with shells containing different shot sizes.

Doughnut or cartwheel patterns are sometimes delivered by European scattergun barrels. These pattern deviations are due to over-choking, but there is little that can be done about it. One other word of caution—the suggestion is often made to mark the aiming point on the patterning paper and draw the circle before shooting. Doing your patterning and counting that way will give you a false picture of the percentage of pattern delivered.

The various plastic wads affect the flight of the shot inside and outside the barrel. Change wads in handloads and your pattern percentage will change. A great many factors influence patterns, as mentioned earlier.

Shooting holes into paper will tell you if the gun shoots where you are pointing, and may show some defects such as blown patterns. Beyond that, no amount of patterning will teach you to swing with the target, nor will it help in figuring your lead. B.S.

See also: HUNTING; RELOADING; SHOOTING; SHOOTING TECHNIQUES; SHOTGUN; SHOT SHELLS.

Shot Number	12	9	8	7½	6	5	4	2	BB
Approximate pellets per oz.	2385	585	410	350	225	170	135	90	50

Buckshot Number	4	3	1	0	00
Approximate pellets per lb.	340	300	175	145	130

➤ *Use this chart to determine how much shot you are firing per shell.*

Coping with the Insect World

Insects have been around for about 200 million years, so you better learn to live with them. Understanding their idiosyncrasies and following these tips should make life outdoors a little less painful

More than 75 percent of all earth's living animals are insects, a statistic that is not news to people who like to be outdoors. If you have ever been annoyed by bees, chiggers, fleas, flies, hornets, wasps, millipedes, ticks or mosquitoes you will probably think the figure is generously low.

Once you've been bitten, stung, nipped on, blood-sucked and buzzed-about from Canada to Chihuahua, from Oregon to Orlando and a few points in between, you are almost forced to learn a thing or two about treating insect stings and bites, discouraging their sharing your campsite or bed. You also learn about exterminating the most voracious and annoying of these scratchy, crawling, buzzing, burrowing, stinging pests that can make life in the great out of doors anything but beautiful.

In defense of most insects, many of them are of considerable importance to mankind. Our lives and those of much of the world's flora and fauna are closely dependent upon insects. Bees, for example, pollinate many of our trees and plants. Some insects are cannibalistic and prey upon other species. This trait has led to the importation of certain insects to control others which cause blight and scales in fruit trees, garden crops, and timber trees.

Insects, either adults or larval forms, are staples in the diets of many of our game fish, game mammals and birds. Bears, for example, love to eat the grubs (larvae) of certain insects. Bears also seek out the honey caches of wild bees to feast on the delicious liquid and comb wax, all the while yelping in pain and annoyance over the numerous stings inflicted by the hive's defenders.

All living creatures have one or more means of defending themselves against enemies. Many run, swim, or fly fast enough to escape. Others use immobility or camouflage to escape detection. Fortunately for us, only a few species defend themselves with stings or bites.

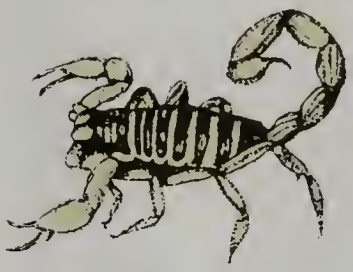
The stinging apparatus, usually associated with the female of the species, is likely to be a part of the egg-laying organ, or ovipositor. The primary function seems to be that of immobilizing another insect. The acid or venom thus injected into another insect paralyzes it and preserves it so that the larvae, hatched from eggs laid on or within the body of the victim, will have a fresh food supply available from the very moment of their birth. Some wasps inject a venom capable of keeping the victim im-

petunias: see garden planning
philippine mahogany: see boat building

The yellowjacket and the bumble bee are equipped to sting more than once. Don't move and you'll escape unscathed. Watch out for the scorpion's curling tail—the poison gland and the stinger mean pain. The tiny chigger, 1/150-inch, can cause a huge itch, and the tick can transmit Rocky Mountain spotted fever.

YELLOW JACKET (4/5 in.)

BUMBLE BEE (1 in.)



SCORPION (4 1/2 in.)

CHIGGER (1/10 to 1/150 in.)

AMERICAN DOG TICK (1/5 in.)

Coping with the Insect World

1933

The black widow spider, easily identified by its bright red marking, has a poison potent enough to kill. The centipede is no friend either —it can cause a serious sore. Hornets and wasps, though painful, are not too dangerous unless you are very sensitive. Brown recluse spider is a hazard to all. Medical care is a must.

BLACK WIDOW SPIDER (1 1/2 in.)

HORNET (3/5 in.)

CENTIPEDE (1 1/5 in.)

BROWN RECLUSE SPIDER (1/2 in.)

COMMON PAPER WASP (4/5 in.)

mobile and "preserved" for a month or more.

The various wasps, hornets, yellowjackets and the common bumble bees can not only inflict a painful sting upon humans when provoked, but they can sting several times in rapid succession. The honey bee, on the other hand, can sting but once. Its ovipositor is equipped with tiny barbs which cause it to hold tightly in the flesh of the victim. When the stinger is used, the entire apparatus, including the venom sac, separates from the body of the bee and remains with the victim. The bee dies soon thereafter but the venom sac, remaining attached to the stinger continues for some time to pulsate and pump additional venom into the wound. For this reason it is imperative that the honey bee's stinger and venom sac be removed from the site of the sting. This is best accomplished by using a fingernail or knife blade operated with a scraping, lifting motion while at the same time avoiding any compression of the sac. Fine-tipped tweezers may also be used to lift the stinger at a point below the sac.

The stings of all the Hymenoptera family, particularly the honey bees and the larger wasps, are extremely painful but rarely have serious after-effects for most.

However, some people are dangerously sensitive to such stings. Wasp stings, for example, are serious nightmares for those who have allergic reactions. Only a few minutes after the initial discomfort of the sting, the afflicted area will swell at an alarming rate. If unattended by a physician, this swollen area will spread as the venom gets further into the bloodstream. If the sting is in a finger, for example, the entire hand and arm will be swollen in a matter of hours. By this time, most people are alarmed enough to seek professional care. Injections of epinephrine and a steroid are all that is needed, and the victim will find the symptoms disappear within three hours of the injections.

But few, if any, of the more painfully stinging insects will commit unprovoked attacks upon humans. Leave them alone and they will leave you alone. Sometimes, however, this policy requires a great deal of self-control. When a wasp or hornet alights upon you, your first, almost involuntary, act is to brush it off. Don't. If you can leave the insect undisturbed for a minute or two, it will usually fly away.

If your campsite is found to be near an insect nesting site, move to another location, particularly if there is anyone in your party who has become sensitized to insect venom.

If moving the camp is not practical there is a simple and effective way of getting rid of wasps, yellowjackets and hornets. Some distance away from the camp, place a bucket of water on the ground under a bush or low-limbed tree. Then suspend a large piece of fish, or other meat (the riper the better), above the bucket. The insects will feed upon this meat, become gorged, fall into the water and drown. It works.

It is hard to understand how a bug so little can cause such a big itch. But chiggers, sometimes called redbugs, do just that. These tiny mites, barely 1/150-inch in diameter, are very big in the itching department and are one of the most unpopular pests the summertime camper is likely to encounter. If you work in a garden, go berry picking, hike the woods or fields, or just stay home and mow your lawn, you're fair and likely game for the chigger anywhere in the continental United States. There are five known species that commonly attack man, but a bite from any chigger is just one big itch.

Fortunately most chigger bites can be prevented by precautionary measures. Many of the proprietary repellents (in both liquid and aerosol form) are effective when sprayed on clothing or skin. Kerosene or powdered yellow sulphur are effective when oil-soaked rags are tied to boot tops or

when the sulphur is dusted around socks, trouser cuffs and other openings in the clothing. Chigger infested clothing should be thoroughly washed after exposure to these dynamites.

The itch may be relieved somewhat by the application of a formula containing: benzocaine 5%, methyl salicylate 2%, salicyclic acid 0.5% in solution with ethyl alcohol 13% and water 19.5%. Your druggist will compound this for you or recommend an effective package substitute. Apply this solution to the welts.

Wood ticks are another scourge of the camper. The term "wood tick" is applied here to several species of ticks whose variations in habits and appearance are of interest only to entomologists. The itch is pretty much the same for all species. However, the Rocky Mountain wood tick and the American dog tick may transmit Rocky Mountain spotted fever, tularemia (rabbit fever), and other diseases of humans and some lower animals. The larvae and the nymphs of the tick family cause trouble and annoyance to humans. The larvae (sometimes called seed ticks) attach themselves to the host animal. In a few days they have filled themselves with your precious blood. Then they drop to the ground, shed again and are adults.

The best offense against ticks is a good defense—in the form of repellents, of course. The repellents recommended for chigger control are effective against ticks as well.

Once a tick has picked you as its blood bank, it should be carefully removed as quickly as possible. Touching the tip of a tick's posterior with a lighted cigarette will cause him quickly to relax his grip on your skin. Lift him off with tweezers, slowly and carefully, making sure that you have the whole tick and have not left his head imbedded in your skin. A volatile fluid, such as nail polish remover, white gasoline, Coleman fuel or aerosol spray repellent, will also anethetize the tick, allowing him to be removed. Treatment of the bite with the benzocaine formula recommended earlier for chiggers will give relief from the itching bite.

Incidentally, ticks and chiggers are biters, not stingers. They do their dirty work with their mouth parts, not with stingers and injections of venom as do the wasps and hornets. It would be wise to consult a physician if you're bitten by ticks while in an area of known incidence of Rocky Mountain spotted fever or other tick-borne disease.

In the southern and southwestern United States, two relatives of the ticks and chiggers may bite with more serious consequences. These other members of the Arthropod clan are the centipede and the scorpion. Both are secretive and nocturnal in their habits, prefer somewhat damp hiding places and are seldom seen by outdoorsmen. Occasionally they may be found in a sleeping bag, in boots or shoes or clothing left on the ground during the night.

The centipedes, not to be confused with the harmless millipede, come in a variety of kinds and colors. All are elongated and flattened, the body divided into a core of segments, each with a single pair of legs. The bite is administered with strong, poison-equipped fangs located just under the head. One Texas variety comes in psychedelic colors of metallic blue body, orange head and yellow legs. It may reach a length of more than eight inches and, of course, may inflict a painfully serious bite for which medical attention is advised. Incidentally, although not poisonous, the legs and hairs of the centipede, and some other insects may cause an itching rash very much like that caused by a thistle plant.

Scorpions, also found in the South and Southwest from Florida to Arizona, have pretty much the same habits as the centipedes. In appearance the scorpions have eight walking legs attached to a segmented

body, the last several segments rounded into a tail that usually curls over the back, with the terminal segment swollen into a poison gland attached to a curved stinger that usually means incredible pain. Good advice concerning both scorpions and centipedes is to look carefully into sleeping bags before crawling in and to shake out boots, shoes and socks before donning them. There is no such thing as peaceful co-existence between a foot and a scorpion or centipede.

Another group of poisonous pets are the spiders. Although all spiders are equipped with poison glands for killing their prey, only a few are of sufficient potence to endanger man. In the United States, the black widow and the brown recluse spiders are capable of inflicting a serious bite. Both are shy creatures, not aggressive, and unlikely to bite unless pressed to do so. These spiders weave their webbs in small dark holes or crevices. They may also be found under loose bark, lumber piles, in knotholes, under loose boards on campground tables, or under rocks.

The black widow spider is easily identified by its glistening black, tearshaped abdomen with a bright red, usually hourglass shaped marking on the underside. The marking may also be in the form of several small triangles with flecks of yellow mixed with the red.

The brown recluse spider's most distinguishing characteristics are the three pairs of white eyes, arranged in a semicircle on the front of the head, and a guitar- or violin-shaped mark just back of the eyes. The body is about one-half inch in length with color ranging from orange-yellow to dark brown, or sometimes almost black. The legs are somewhat darker in color than the body and covered with short, dark hairs.

Victims of the bite from either of these spiders should be taken to a doctor immediately. If possible take along the spider for identification. Initially, the bite of either spider is usually less painful than that of a bee sting, but it may gradually become more severe and may be agonizing after 8 hours or so. Within 36 hours after a bite from a brown recluse, vomiting and a fever of 103° to 104° may result. The fever has been known to last for as long as a week with other symptoms in serious cases.

The brown recluse spider is quite common west of the Mississippi. Scattered reports have come from some eastern states. Black widow spiders have been found in Virginia at elevations up to 2500 feet.

If you suspect some member of your party to be hypersentive to such stings or bites—and any person who has previously exhibited a systemic reaction, a large local reaction, or reactions of increasing severity may be suspect—then, by all means, that person should consult a physician or dermatologist before going afield. In fact a sensitized individual may be in just as much, or more, danger when working around the yard, on the golf course or even indoors. The doctor can recommend special precautions or prescribe a first aid kit.

In some cases the physician may recommend a course of desensitizing (hyposensitization) using an insect extract mixture of honey bee, wasp, hornet, and yellowjacket venoms. This hyposensitization has proven highly effective, reducing severity in some cases by as much as 90 per cent, according to the Insect Allergy Committee of the American Academy of Allergy.

The most effective defense against bugs is to learn more about them, their interesting life histories, habits, and how to recognize them.

Who knows? You may become so interested in bugs you will be trying to attract them to your campsite. After all, the insects have been around for about 200-million years. We had better learn to live with them.

See also: CAMPING; FIRST AID.

Photography for Beginners

If you are serious about photography, start right out with an adjustable camera. If you use it according to these fundamentals, you will be taking sparkling, professional-looking pictures in no time

YOU DON'T NEED TO BE a professional photographer to take crisp, clear pic-pictures that are interesting in themselves —even to someone who doesn't know the people in them, or who has no interest in your last vacation.

You do, however, need knowledge, experience and a serviceable camera. You could use a simple, non-adjustable camera, but only within a limited range of conditions. With an adjustable camera—one whose lens opening, shutter speed and focus are controlled by the operator—you have an infinite range of images at your fingertips.

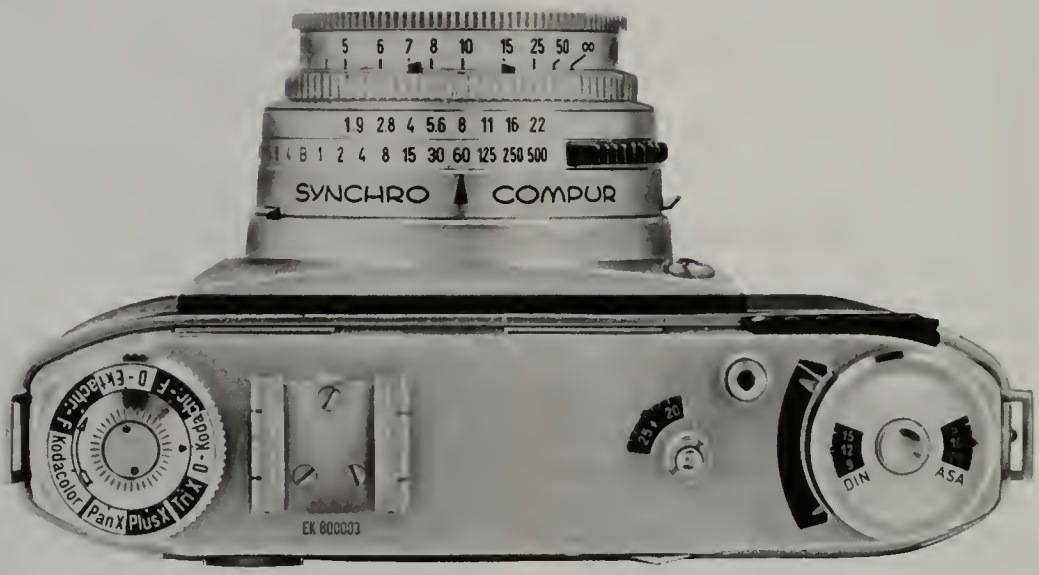
Every adjustable camera has only these three controls—lens opening, shutter speed and focus—whether you pay $60 for it, or $600. Each in some way regulates the way light enters the camera and strikes the film.

Lens opening, or aperture, controls the amount of light that enters the camera while the shutter is open. If the lens is open wide, a big burst of light strikes the film. If lens opening is at its smallest, the film receives just a squirt.

The size of the opening is indicated by an f/number. The f/numbers usually run in this sequent: 22, 16, 11, 8, 5.6, etc. The largest number indicates the smallest opening and vice versa. Confusing? Think of the number as indicating a restriction of light. The larger the number, the greater the restriction.

Sometimes f/numbers are called f/stops. Opening the lens to the next larger opening is called opening it one stop. Each time you do this you double the amount of light that can enter the camera. Adjusting the lens to the next smaller opening is called closing it one stop. Each time you move from one lens opening to the next smaller one, from f/11 to f/16, for example, you halve the amount of light that can enter the camera.

The shutter of an adjustable camera is a gate that lets in light when it is open and shuts it out when it is closed. Shutter speed



A typical adjustable camera. The controls are on bands around the lens. Starting from the arrow and going up, the first band regulates shutter speed. The one directly above it controls lens opening (the f/stops run from 1.9 to 22) and the one at the top controls focus. The camera is set at a shutter speed of 1/60 second with a lens opening of f/8 at a range of 10 feet. Depth of field, indicated by the pair of markers on the focusing scale, is between 8 and 14 feet.

means the length of time that the shutter remains open when you press the shutter release.

The control that regulates shutter speed is usually marked 30, 60, 125, 250 and 500, although other number sequences close to these might be used. Each of the numbers is a fraction of a second. 30 means 1/30 of a second and so on: 1/60, 1/125, 1/250, 1/500. Doubling the amount of time the shutter is open—going from 1/250 to 1/125, for example—doubles the amount of light that enters the camera. Halving the time, halves the amount of light.

The third camera control is the focus, or range. This is the distance that the camera is looking at. It works something like your own eye. With one eye closed, hold your finger up near your open eye and concentrate your gaze on it. You will see your finger in sharp detail, but anything in the distance beyond it will seem vague and fuzzy. Try the reverse. With your finger in the same position, focus your eye on something in the distance and your finger will appear blurred.

The distance control of your camera is marked in feet. You can focus your camera by estimating or measuring the distance to your subject and adjusting the focus control accordingly, but this is an awkward and impractical method for much photography.

Most adjustable cameras have range finders, which are more accurate than estimates. There are two main types, the split image and the superimposed image. With either type, you look through the view finder at the subject and adjust the focus control until the two halves of the split image are aligned or until the two images of the superimposed image system become one.

The film in your camera is coated with a chemical that responds to light. When it

is struck by light, the chemical undergoes a change. Later, when the film is developed, the chemical crystals that have been exposed to light remain in the film and form a black image. The crystals that did not receive light are washed away. This developed film is a negative. What was light in the original scene is dark in the negative. What was black appears as white.

The next step is to shine a light through the negative and onto a sheet of photographically sensitive paper. The process is repeated. Where the light strikes the chemicals in the paper they turn dark. The reversed image is reversed again so the black appears as black and the white appears as white in the final print.

However, this only works when the film in the camera receives the correct amount of light. Too much, and the photograph will look pale and washed out if it isn't just a white blur; too little, and the photography will be dark and murky. At worst, it could be completely black.

There are several ways to arrive at the combination of lens opening and shutter speed that will admit the exact dose of light needed to make a usable image on the film. The best way is to use a light meter. If there is one built into your camera, always use it. Another way, which works much of the time, is to make a rough estimate based on the exposure instructions that come with every roll of film.

One widely used film, Kodak's Plus-X Pan, for example, has an exposure table that recommends a shutter speed of 1/250 second in bright or hazy sunlight with an aperture of f/16 for very light subjects and f/11 for average ones. For the same film, use a speed of 1/125 of a second at f/8 for cloudy bright days (no shadows) and at f/5.6 for heavy overcast or open shade.

So far, so good, but what if it's a bright Saturday afternoon and you want to stop the action of a Little League baseball game? Set your shutter speed at 1/500 of a second instead of 1/250. This will stop most action, but it will also halve the amount of light entering the camera, so one more adjustment is necessary. Remember the effect of opening the lens one stop. It doubles the amount of light that can enter the camera when the shutter is open. In this case, change the lens opening from f/11, which you would ordinarily use with 1/250 of a second in these light conditions, to f/8.

People who are interested in what they are doing make interesting photographs. One way to avoid a stilted posed look is to photograph your subjects while they are active, such as the people in this scene.

Oops, somebody moved the camera. When shooting at 1/60 of a second or slower, hold the camera steady and squeeze the shutter release smoothly, so this will happen.

Letting light into the camera is like filling a bucket exactly to the top. If you open the faucet all the way, water fills the bucket quickly. If you allow just a trickle to flow, filling the bucket takes a longer time.

When you took that action shot of the baseball game, at 1/500 of a second, opening the lens one f/stop had an additional effect besides allowing more light to enter the camera. It decreased the camera's depth of field.

Depth of field is related to focusing. If you stood at the end of a long picket fence and photographed along it, the pickets very close to you would be blurred and out of focus. As the distance from the camera increased, the pickets would be sharply defined. Then at a greater distance they might become blurred again.

Think of what you see in the view finder not as a flat surface but as a box whose depth varies with the size of the lens opening. The smaller the lens opening, the longer the box. Usually at the smallest opening, the depth of the box is infinite. Everything beyond a certain point fairly near the camera is in focus.

Depth of field is always indicated on an adjustable camera, usually on the focus adjustment, but sometimes on a separate dial. In a typical camera, if you are photographing something 10 feet away and the lens opening is f/8, there will be a tick mark or other indication at about 8 feet and another at 15 feet. This means that everything between 8 and 15 feet away from the lens will be in focus. Everything nearer or farther away will not be so sharply defined.

Although depth of field sometimes can limit the use of a camera, it can also be an asset. If, you want to eliminate a confusing or unsightly background, you can increase the lens opening to make the depth of field shallower and increase shutter speed. Focus on your subject and snap the picture. The result will be a sharp rep-

When using a split image (top, left) range finder or superimposed-image (top, right) range finder, simply manipulate the focus control to bring either of the divided images together (at right) and the subject will be in focus.

resentation of the subject with the unwanted background blurred in the distance.

The type of film you use in your camera also affects your choice of lens opening and shutter speed. Films vary in their sensitivity to light. Some are slow and some are fast. Slow means that the film requires a lot of light to form an image. Fast means that little light is required.

Each type of film has a number called an ASA speed number that indicates its sensitivity. The Kodak Plus-X Pan general purpose film has an ASA speed of 125. One widely used slow film has an ASA number of 32. This kind of film generally will pick up extremely fine detail and will yield photographs with sharp clear edges. It is especially useful when you intend to make big enlargements.

Another widely used film has an ASA number of 400. This is very fast. Film of this types requires relatively little light to

form an image and is well suited to photography where the available light is weak—indoors without a flash, for example. It has one disadvantage. Its fine details are somewhat less sharp than with slower film and it does not enlarge as well.

When loading your camera with film, be sure to set the film speed number on the built-in light meter, if your camera has one. If it doesn't, it may have a simple dial to turn that will indicate the type of film it is loaded with. This will serve as a reminder when you are adjusting exposure. Another convenient way to remind yourself what kind of film you are using is to tear off the portion of the film box where the type and speed are printed and tape it to your camera bag or case. It only takes a second and it can spare you the disappointment of losing a roll of photographs because of mistakes about exposure.

If you are taking pictures of people and you follow the old rule of letting the light come over your shoulder and fall on the subject's face, you are going to get pictures of a lot of squinting people.

Instead, try photographing people in open shade—not under a porch roof, but next to a tree or building where they are shielded from the direct rays of the sun but are open to the sky.

Or, wait for an overcast day. This kind of diffused light is flattering to people and they feel more comfortable in it than in direct sunlight.

Another method is to let people provide their own shade. Have your subject turn his back to the sun. The light from the

➤ *Child's face dominates this picture because lens opening was opened to reduce the photograph's depth of field. Background and foreground are blurred, while the face appears in sharp detail.*

People in foreground give perspective and depth to outdoor scene.

sky will provide a flattering glow and the sun from behind will edge the subject in a halo of light. When you do this, increase lens opening two stops and make sure the subject is blocking the sun from the camera.

Taking pictures of small children is easy because they are often so engrossed in what they are doing that they pay no attention to the camera, and if they do it's because they are interested in the camera or the photographer, not because they are posing.

These qualities make children ideal candidates for vivid, natural-looking photographs. Keep the camera low and stay fairly close to the subject.

Older children and adults often become self-conscious when they are photographed. Overcome this by keeping them busy at something. Photograph them while they are at work or play, or give them a prop—a book will do it—to divert their attention from the camera.

Whenever you take a picture, think as you look through the view finder, what is this picture about? Is it a person, or an activity, an object, a landscape? Then, try to include everything relevant to the answer and exclude everything that isn't.

If the picture is of a person, move close enough for the person to fill the frame. Avoid cluttered backgrounds. A low camera angle will put a lot of sky into the background, or you can dissolve the background into a blur by using a wide lens opening and, of course, a faster shutter speed.

Framing a scene can add a sense of perspective and depth to a photograph. Framing means using some natural feature to frame or partially frame the scene that you are shooting. It might be a fence post and rail in the foreground if you hold the camera low and shoot through a fence, or it might be tree branches.

One way to add depth to a landscape is to include a human figure. The relatively small stature of a person in the foreground will add height and scope to a distant mountain because the figure of known size gives the viewer's eye a standard of comparison when it sees the photograph.

Action photos, like the shot of the Little

League game, require fast shutter speeds, or they will be blurred. Even during the tiny interval of 1/125 of a second, a subject can move enough to form a blurred image on the film.

Try using 1/500 second, or 1/1000 if your camera has it, and try to catch the subject at the peak of action. If you are photographing a galloping horse, snap it at the top of its stride, when, for a split second, it almost glides and the action of its legs is least. Another tip: it's easier to stop action that is moving directly toward or away from you than it is to stop it if it moves from one side to the other.

If poor light or low film speed prevents you from shooting at 1/500 second or fasters, you can still take action shots by panning the camera. Panning is following the action with the camera, as if you were trying to shoot a moving target with a rifle.

Suppose you want to photograph a racing automobile. Take a firm stance and rotate from the waist, moving the camera so the background appears to move in the view finder, but the car seems to stand still. Because the camera is moving with the automobile, there is little relative motion between it and the camera. The car will appear on the film as a sharp image, but the background will be streaked, giving the photograph a sense of speed and motion.

Take a look at some outdoor black and white snapshots and count how many clouds you can find. Probably very few. This is because the clouds and the sky have about the same brightness. To the human eye, clouds stand out as white against a blue background, but to the black and white film in your camera, they are about same. Each shows up as nearly white.

You can correct this by using a filter. Filters are pieces of transparent material tinted with colors that fit in front of the camera's lens.

The most convenient filters to use are made of tinted optical glass and are fitted with threaded rings that screw onto either the camera lens or an adapter ring.

Each filter lightens its own color and darkens its complementary color. One commonly used filter, yellow, will make yellow colors appear brighter and darken purples and blues on black and white film. A red filter will darken a blue sky even more. Try using either of these filters for

Fast film was used to capture this action scene using only available indoor lighting. Also, the photograph was shot at the peak of the action, when motion, for a tiny fraction of a second, was at a minimum.

➤ *Framing effect of the stone steps and post give this photo depth. Note the halo effect around model caused by partial backlighting.*

the next outdoor pictures you take, especially on days with big fleecy clouds. The clouds will appear bright and well defined and the sky will be dark, possibly darker than its true value as you see it with your eyes.

There is a great variety of filters available, some for use with black and white film and some for use with color. Some adapt film designed for use with natural light so it can be used with artificial light and vice versa.

One useful filter is a polarizer, which will eliminate glare and reflections. It will also darken the sky and, in color photography, make the colors appear more intense than they would be ordinarily.

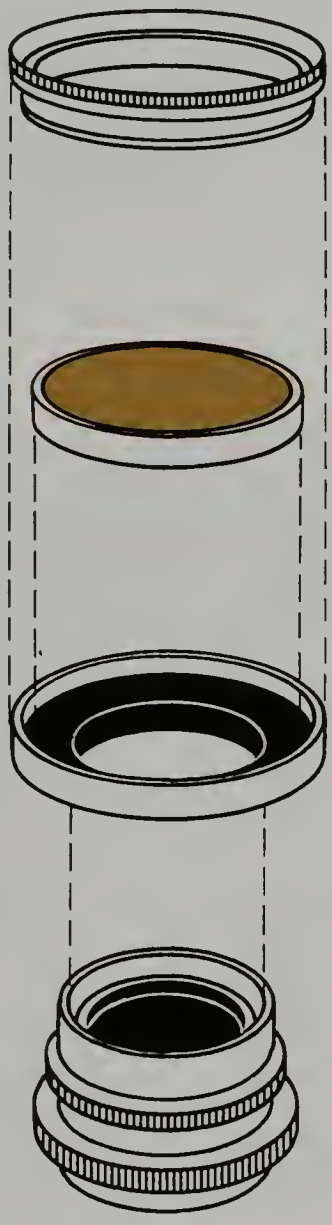
When you use filters, remember that these devices reduce the overall amount of light entering the camera, so you must use a slower shutter speed or a larger lens opening to compensate for the loss of light. Filters come with instructions on the amount of compensation they require.

You needn't put your camera away when you bring it indoors. If you have a camera with a built in light meter, or have a separate light meter, you can keep on shooting with available light, or you can use flash.

Flash bulbs come in two types, blue and white. White flash bulbs are for use with black and white film. Blue flash bulbs can be used with either black and white or color film, as can electronic flash. Use the bulb or electronic flash that your camera manual recommends, and be sure to use a suitable film.

Exposure for flash is determined by the type of flash, the type of film and the distance of the subject from the camera. Subject distance is important because of the intensity of light falls off sharply as it travels from the source, bounces off the subject and returns to the camera.

The instruction sheets that come with rolls of film all include a flash guide. The guide will allow you to determine the flash guide number for the type of flash and shutter speed that you are using. When you determine the flash guide number, divide the distance in feet from camera to subject into the flash guide number and the result will be the proper f/stop. If the result is not an exact f/stop, use the nearest one.



Tinted optical glass filters are the most practical for all-around photography, although they are more expensive than some other types. These filters sometimes can be screwed directly onto the lens, but usually they require an adapter ring and a retainer ring, as shown here.

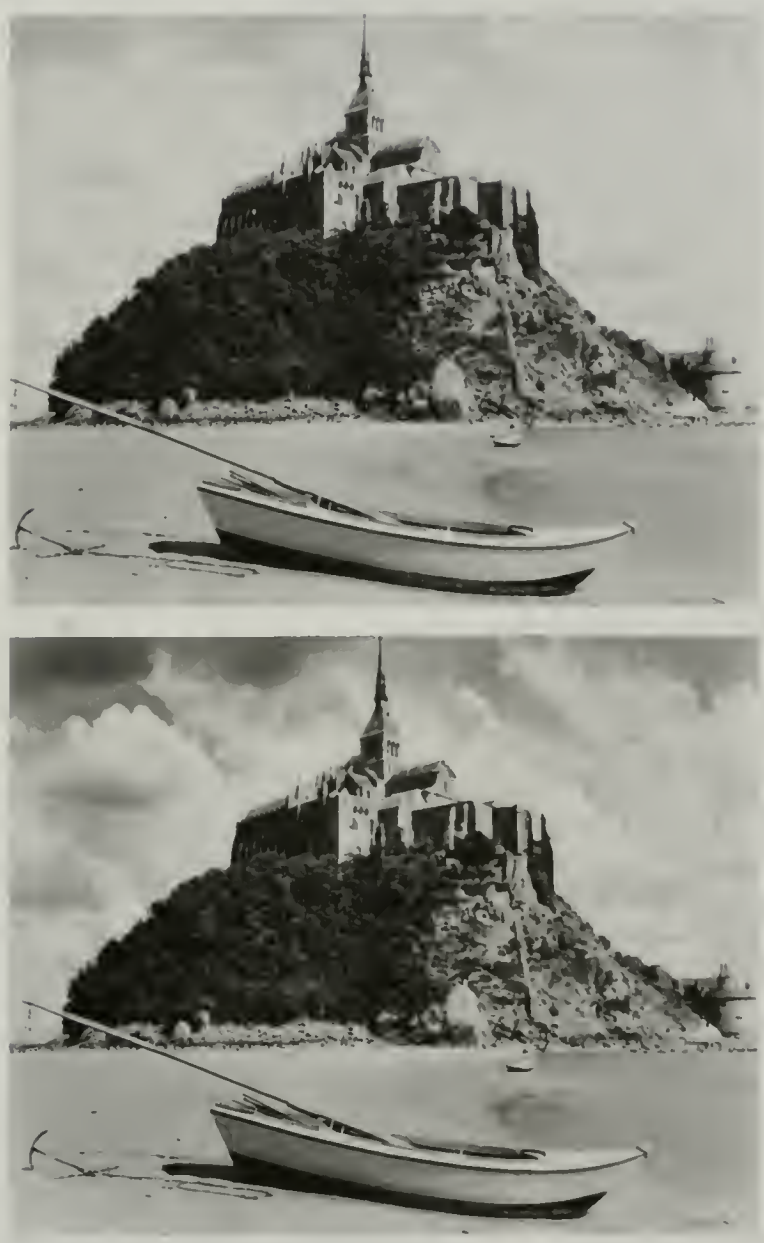
For example, if you are shooting with Plus-X Pan film at a shutter speed of 1/125 second with a flash cube, the guide number is 60. If the subject is 6 feet away, divide 6 into 60. The result is 10. Since f/10 isn't indicated on your camera, use f/11.

Cameras equipped to accept flash have X and M settings. The correct setting for the kind of flash you are using will be indicated on the package. The X setting is for instantaneous flash, which is provided by electronic units and some bulbs. The M has a built in delay for flash bulbs that reach their peak brightness a small fraction of a second after they are triggered.

If you are not sure about which type of bulb you have, use the X setting and a shutter speed of 1/25 or 1/30 second. This setting will work with any kind of bulb or electronic flash.

Avoid dark shadows when taking indoor flash pictures. They distract the viewer from the subject. If the subject is next to wall, for example, he will cast a sharp, dark shadow. Keeping the subject a few feet away from the wall will soften the shadow and make it larger. Also, shiny surfaces, windows and mirrors can result in unwanted spots of glare in the photograph. If you see anything that will reflect light back toward you as you look through the view finder, change the camera angle, or move the subject.

Using bounce flash can eliminate the hard, severe look that many direct flash photographs have. If you can remove the flash unit from your camera, hold it in your hand and aim it so that the light bounces to your subject off a white or nearly white



The effect of filters is illustrated in these two photographs. The one at left top was taken on black and white film without a filter. The scene was photographed again with the same film, but a yellow filter was used to darken the sky. The result (left, bottom) shows the clouds as they would appear to the human eye.

ceiling or wall instead of traveling direct. Open the lens two stops more for bounce flash than you would for direct flash. If you are shooting with color film, use only a white ceiling or wall for bounce flash.

Some adjustable cameras have built-in exposure meters that make it possible to take pictures in marginal lighting conditions, where a rough guess based on the instructions that come with the film simply would not be precise enough.

On cameras with built in exposure meters, make sure you set the exposure meter to the ASA film speed number. This

is usually done by turning a dial, but see your camera manual for exact instructions. Then, the meter will let you know whether or not your exposure setting is suitable for the amount of light available. This will enable you to take photographs indoors, or in deep shade, at dusk or at dawn, or on heavily overcast days, especially if you use fast film.

The exposure meter is far more accurate than guesswork, but it can be fooled. In most cameras it is designed to respond to the overall scene viewed by the lens. If the main subject is signficantly darker or brighter than the rest of the scene, the light meter won't know it. In cases like these, shoot at a smaller lens opening if the subject is very light, at a larger one if it is very dark or in heavy shadow.

You can also use your camera after dark outdoors. With a tripod and a time exposure, you can photograph city skylines or brightly illuminated buildings. You can also photograph on well lit city streets, as in theater or shipping districts. It is also possible to take pictures by the intense illumination provided at athletic fields and sports arenas.

These fundamentals may seem like a nuisance to a beginning photographer, but if you use them faithfully, you will quickly acquire them as habits. They will become part of the way you think when you take a picture, and the results that you see on your finished photographs will be well worth the effort it takes to develop your skill as a photographer. F. C.

See also: CAMPING; DARKROOMS; MACROPHOTOGRAPHY; PHOTOMICROGRAPHY.

Shiny surfaces, windows and mirrors can reflect light from a flash back at the camera and produce glare spots on the film, as above. Check camera angle carefully and, if necessary, change it to minimize risk of reflected glare.

➤ *Telephoto lens, patience, and timing were the key elements in getting this shot of a boy with his first fish. Since range finder cameras operate faster, they are best for critical timing.*

Photography on the Camp Trail

If you plan for photography in the same way you do your driving route or supplies, you'll have guaranteed satisfaction in the pictures you take

IF YOU MAKE picture planning part of your advance preparations for any camping trip, just as you would figure your driving route or the food you'll carry in your back pack, the ultimate results of better pictures will be enormously satisfying.

If you are camping by trailer, motor home or tent trailer, the photographic problems are much akin to photography in the house or outdoors in the neighborhood. Since the camper covers a lot of ground, he sees many rare sights and scenic wonders while in transit. He should learn to produce photos that have excellent scenic quality (sharpness and saturated colors) in the transparency or final print. He must also acquire the skill to create or capture good family groups and snapshots inside the trailer or camper. These needs would suggest a camera with good quality normal lens and an interchangeable feature for a second lens, preferably a wide angle. There are other accessories that would be helpful but are not necessary to your photography fun, such as light meter, tripod, filters, cable release, and others, but that will be covered after the basics.

In choosing a camera outfit, the amateur's first consideration is the cost of equipment. It is assumed the reader is looking for more than the Instamatics. If

your camera equipment budget is limited to the area of $100, you should stick to one of the better cartridge-loading cameras for all your picture needs. This outfit is perfect for car travel, backpacking, horseback, even sky diving. However, if you can afford a somewhat greater allowance, there are many options and choices for the camper.

If you don't already have a 2¼ camera, it would be best to eliminate that film size from consideration even for the camper who is strictly limited to vehicle camping. If you already have, and are using successfully for scenics and snapshots a 2¼ format camera, it's best to stay with that equipment. But get a wide angle lens for use in the interior of your car. Size and weight differences between 2¼ and 35mm film size are not significant for the car camper.

For those car campers who have a healthy allowance, you should consider the Leicaflex, Canon, Nikon, Pentax, Minolta categories. They all have built-in light meter models which are practical for campers, plus flash or strobe attachments and a wide array of lenses from which to choose. You need a 50-60mm and a 28mm or wider lens with minimum distortion.

Advance planning is easier in car camping than others because the storage areas for films and accessories are away from extremes of temperature. When traveling in a camper, carry your cameras in a dustproof box on the floor near the driver's seat. Keep the wide angle lens on and have it loaded with Kodachrome II color film. The shutter should be set on 200th of a second or faster which enables you to stop the action of people or animals at average

Water, to catch the light and to reflect your subject, is a very useful picture element. Exposures are tricky; bracket shots to be sure.

distances. The wide angle is used so you can utilize the windshield or side windows for framing the scenes you photograph from the driver's seat. It also allows you to photograph inside the car, if it's a bright day.

The floor box is made of wood and padded with foam rubber inside. The lid is hinged toward the back of the camper so it doesn't pop open on sudden stops. The lid has a rubber lip to keep the dust out and a snap fastener that flips at finger touch. The box is weighted with lead at the bottom, for stability. Do not bolt it down because then you cannot change the position easily. A sturdy shoe box with flat lead weight on the bottom and foam rubber on top will work as well. You might have to use plastic bags over cameras and lenses to keep them dust free. Tape the lid on.

It might be a good idea to keep your second lens in the box too, with a divider between camera and lens, which is wrapped in a loose piece of chamois. Also, keep one extra roll of film in the divider with the second lens. You can shift to "Park" with your right hand, flip the lid of box and reach camera with the left hand as you twist to open the door. You will be ready to shoot pictures when your feet hit the ground. It's not even necessary to examine the camera if you develop the discipline to set it on the correct markings in advance.

You may ask, "what's the advantage?" The answer is simple. Our eyes see many marvels of this great earth as we roam the highways, but seldom do we capture on film the peak of a perfect cloud formation, or sun angle, or rainbow, or moose in the swamp, or Junior bugeyed at a black bear looking in the window at Yellowstone, or mother-in-law snoring with Mt. Rushmore outside the window.

For better pictures from your car, remember to stick to what has been a successful camera for your general at-home photography. If you have a choice, get the best single lens reflex camera with built-in meter. Carry equipment in a dust-free, weighted box at your feet in your vehicle. Have shutter of your camera set on 200th of a second. Mail away your exposed film immediately for processing, or store in a cool, dry place.

Planning photography for a backpacking expedition depends upon the specific trip you have in mind. One has to take into consideration the season, temperature, weight of pack, terrain, duration of trip, risks and other people involved. There just is not one perfect camera outfit that will serve all outdoor needs.

◄Be prepared for the unexpected; pre-set camera so thet you only need to focus.

Hunting with your camera is often a waiting game; requires ability to remain motionless and quiet in blind, or camouflaged.

Many believe the Leica M series cameras to be the closest to ideal for tough, rugged use. It has the strongest construction and trouble-free operation. It can be winterized for smooth operation down to 50 degrees below. The focal plane shutter stays quite accurate at below freezing conditions. Avoid the danger of losing the bottom piece (base plate) in the snow while loading by attaching a short length of strong nylon line; screw and hook to the base plate and splice the other end to the ring on the camera body where the neck strap attaches. Leica, being a range finder camera, is easier to focus under conditions of driving rain or snow while wearing goggles. The disadvantage is that these Leicas (except the M-5) do not have built-in light meters, and that means a separate meter, adding more weight to your total photo gear.

Leica is a fairly heavy camera for its size. One Leica M-4 body, two lenses and a light meter weigh three pounds; with a 90mm telephoto, the weight is three and three-quarter pounds. If you take six rolls of film, 36-exposure, that's another half a pound.

If you plan to buy a Leica, the M-5 is the only M-series camera now produced, although earier, meterless models are still available, used.

Many models of lightweight cameras have been tested with built-in meters and wide lenses in the hope of finding one camera that would work as well for color. All of them have Compur shutters which lose accuracy with age and especially in cold

Photography on the Camp Trail *1953*

Backlighting and low angle combine to add drama to this photo; use care to prevent direct sunlight from striking lens.

weather. If there is one thing the color photographer needs most, it is an accurate shutter. Many claim the 21-ounce Olympus 35SP to be the best of those tested, which included the miniature Rollie, Konica C35, Kowa Set R2, Yashica, Ricoh TLS, Fujica ST-701 and Minolta HiMatic 7S. At the prices these cameras range, they can be considered somewhat expendable in the event of accident.

A good test to learn these techniques is to plan a sample trip with two couples, summer backpacking in the area of the Grand Teton, where there would be fly fishing for trout, maybe some elk or moose near lakes and water holes, snow at the high altitudes, waterfalls, campfires, social times, and swimming. Make a one week trip with congenial friends who would cherish every snapshot of this adventure. Here is how to decide on the camera and equipment to take. After you have worked out the packing arrangements for each person according to his strength and ability to carry, try the pack load to see if you think you can carry another three or four pounds. If you can, take one camera and three lenses (28mm, 50mm and 90mm), and one roll of film for each day. Leave the film in the aluminum cans, and pack it in an outside pocket. Wrap the camera and lenses in chamois cloth or leather pouch, inside a sealed plastic bag, with wool socks around for protection from water and shock. In other color coded "stuff" bags, carry a syringe, lens tissue and brush, filters, sunshade and a small screw driver. It's risky to carry a heavy pack and still have

your camera around your neck, ready for shooting, unless you know the terrain and can avoid stumbling. You can get seriously injured from falling on the camera, or having it swing up and hit you in the head.

Now your picture planning has just begun. With a map of the route and the advice of a ranger or a local camper, mark the spots where you think you can take the most beautiful pictures. Try to gauge the areas to catch the reflection of the peaks in lakes, etc. Do a "dry run" in your mind, like the astronauts do on the ground before space flights. Backlit pictures can be the most exciting and dramatic possible outdoors. Shooting towards the sun, near water, gives a sparkle and glow to silhouettes of figures against that reflection. Using back lighting just requires some practice, so the sun doesn't hit the lens and cause flare (a "washed out" area often the shape of the diaphragm). Sometimes one needs to shoot from under trees or behind a friend or use a hat in addition to sunshade to protect the lens, but the extra effort is well worth the trouble. Try to arrange your arrival or at least your picture taking, to a time when the low light is full on the falls or mountain. Learn the sunrise and sunset times and be up at dawn to see if mist is rising off the stream or lake. As you walk along, study the light coming through trees and leaves and try shooting directly up at the pattern of sun and leaves when you stop for midday rest. At the end of the day, if you could be excused from building the campfire, set the camera out and watch for a chance to shoot silohuette pictures of your friends against the high roaring flames while there is still a glow in the sky. Take the first shot of each situation according to the meter reading for correct exposure and then take at least two more shots of the exact situation but with the lens opened or closed down at least one full stop. For example, if the correct meter reading is 100 at f/5.6, then take the second picture with the aperture set at f/8 and the third at f/4.5. With unusual lighting situations at sunset or dusk, you will be surprised at how often the correct reading on the meter is not the best setting! As the light fades, you will prop your back against a tree, set the shutter on a 25th of a second and sit braced with elbows on knees and continue to take experimental pictures of the campfire and campers, squeezing off slow shutter exposures, using your forehead as a brace for the camera.

Plan to shoot fishing action one day and, of course, the prize fish being held aloft by the fisherman. For outdoor still lifes, arrange a mountain trout on a rock while it is fresh and wet in its natural beauty, a bouquet of wild flowers and perhaps a rusty Buck knife nearby. Campers bathing in a stream or waterfall make exciting action—be ready. That event doesn't happen more than once on a trip, because the water is so shockingly cold.

For better backpacking pictures take only the camera weight you can carry, packed in a wool sock and plastic bag for protection. Use an outside pocket. Plan your photography with a map and knowledgeable guide. Look for dramatic back light scenes near water. Use shade to avoid flare on lens. Experiment with earlier and later light. Take at least three different exposures of each unusual lighting situation. Save exposed film in aluminum cans and seal in plastic bags. Squeeze off slow shutter exposures, just like shooting a rifle. Brace yourself against tree or rock. Learn to think of light and pictures as you walk, watching for effects of shadows and light.

The thrill of picture taking is 50% in the search and finding syndrome. It's treasure hunting as a creative expression. The other 50% of the total thrill comes from seeing the pictures on your projector and reliving vicariously the excitement of the trip.

See also: CAMPING; DARKROOMS.

Photographing Your Favorite TV Scenes

With a little knowledge and some basic camera equipment, you can film your TV stars right in your own home

HOW WOULD YOU LIKE to photograph the President in the White House? Hank Aaron clouting one over the fence? A U.S. Olympic track star winning a Gold Medal? Or how about your favorite actress receiving an Academy Award? You can snap your camera's shutter at home while focused at your black-and-white or color television set.

Camera and film. You can use almost any camera for taking black-and-white pictures of television images. However, you'll get better results with an automatic or adjustable camera. If you have a simple camera without exposure or distance settings, you must use a high-speed film. For taking color pictures, you should use a camera with an f/2.8, or wider, lens and a shutter that you can set at 1/8 second or slower. If you want to take movies, you will need

a movie camera with at least an f/1.9 lens opening.

To determine the correct exposure, you can use an automatic camera or a reflected-light exposure meter. If you do not have either of these, you can set your camera according to the Exposure Table.

TV images are quite dim compared to average subjects in daylight. Therefore, to avoid using wide lens openings and very slow shutter speeds, you may want to use a high-speed film, ASA 400 or higher, for black-and-white prints; or ASA 160 for color slides.

TV set set-up. To obtain the best quality in your photographs, adjust your TV set so that the contrast of the television picture is slightly lower than normal. Adjust the brightness control so that both the high light and shadow areas of the TV image show detail. The shadows should not be light gray or complete black. Adjust the controls on a color set for a pleasing color picture on the screen.

Reflections on the face of the television tube can ruin your photographic attempt. To help eliminate reflections, turn off all of the room lights. Eliminating the light in the room also helps make the area surrounding the TV image appear black in your photographs. A black area surrounding the TV image is usually more pleasing than a lighter area showing part of the room or the border around the picture tube.

Do not use flash or flood lighting to photograph television images. These light sources actually reduce the brightness of the TV image, and your pictures would show a blank television screen.

Shutter snapping. Move in close to the television screen with your camera. If the minimum focusing distance for your camera will allow it, move in until the TV screen fills the picture area in your view finder.

If your camera is a single-lens reflex with through-the-lens viewing, when you look through the view finder you'll see exactly what you'll get in your close-up pictures. But if yours is a range finder, it probably will not show what you will get. You should compensate accordingly.

Shutter speed. Television images are composed of 525 straight horizontal lines called "scanning lines." The image is formed in your TV set by a moving electron beam which scans the picture in two sections. All the odd-numbered lines are traced in 1/60 second to produce an image. As soon as this cycle is completed, the picture is scanned again in 1/60 second, this time tracing the even-numbered lines. Therefore, it takes $\frac{1}{30}$ second to make a complete picture on the screen. So you must use a shutter speed of $\frac{1}{30}$ second *or* slower to record at least one complete picture cycle. Otherwise you may get a dark band across your photograph. If your camera has a focal-plane shutter, you should use a shutter speed of $\frac{1}{8}$ second or slower to obtain uniform exposure. For sharp pictures, make the exposure when the subject on the screen is not moving. Put your camera on a tripod or other firm support, such as a table. Books and boxes can be used if the tables you have are too tall. Do not tilt camera up or down to capture picture. Rather, raise or lower camera until picture is framed properly.

Color pictures. Use daylight color film for photographing TV images. Color pictures of color television will have a somewhat blue-green appearance because the film's sensitivity to the TV picture is different from the eye's sensitivity. You can improve color rendition in your pictures by using a color compensating filter, a gelatin filter works best, over your camera lens to help bring out the reds. When you use the filter, increase exposure by one stop. You can pick up this filter from your photo dealer.

Automatic cameras. Fill the picture area in the view finder with the TV image so that

Photographing Your Favorite TV Scenes *1957*

New high-speed super-8 movie cameras make color TV photography a snap.

Expensive equipment is nice but not necessary. Ordinary fixed focus camera is fine for photographing live-from-the-moon TV at home from large-screen set.

the exposure meter in your camera "sees" only the TV screen. If your automatic camera (with built-in exposure meter) is too far away from the TV screen, the exposure meter "sees" too much of the dark area surrounding the TV image, resulting in over-exposure on your film.

When you are taking pictures, the low-light indicator may appear in your camera view finder. Usually you can ignore this "warning" and take pictures anyway. You will probably get satisfactory results, although your pictures may be on the dark side.

If your automatic camera has a separate peep hole for the light meter, you must cover this peep hole with the filter when the lens is so covered. If not, your photos will be overexposed.

Adjustable cameras. If you have an adjustable camera with a built-in exposure meter, when you make the meter reading be sure the TV screen fills the picture area as recommended for automatic cameras. If your camera does not have a built-in meter, you can use a separate reflected-light exposure meter to determine the exposure. Hold the meter close to the TV screen so that it reads only the screen. Position your meter to read approximately equal parts of light and dark areas of the TV picture.

Simple cameras. The camera settings in the Exposure Table apply to most television sets and are a good reference for simpler cameras. However, since individual adjustments of TV pictures can vary, and since improvements are continually being made in the picture tubes for color television, the suggested exposures are approximate. You may want to bracket your exposure to be sure of getting a properly exposed picture of an especially important subject. Take one picture at the suggested exposure, one at ½ the exposure and another at 2 times the suggested exposure. Remember do not use shutter speeds higher than $\frac{1}{30}$ second or ⅛ second for a camera with a focal-plane shutter.

Movie cameras. To make good-quality movies of television images, you would need a special camera synchronized with the television set to record successive picture cycles on successive frames of movie film. Of course this is not practical for the amateur-movie maker. However, you can still obtain satisfactory results with an ordinary movie camera that has an f/1.9 or faster lens.

Operate your camera at the normal camera speed of 16 or 18 frames per second. Since your movie camera is not synchronized with the TV picture cycle, your projected movie will show a slightly uneven, or banding, effect.

With a camera that has an f/1.9 lens, you can make recognizable, though somewhat dark, movies of black-and-white and color TV images when you use Kodachrome II Movie Film (Daylight); or Kodachrome II Movie Film (Type A) with a No. 85 filter. This filter is built into all super-8 cameras and some 8mm cameras. When using these films, turn up the brightness control on your TV set for maximum brightness, without losing too much detail. If your camera has manually adjustable lens openings, set the lens at its largest opening.

You can obtain brighter movies of black-and-white images by using the Type A film without a No. 85 filter. The black-and-white images in your movies will be somewhat bluish, but will certainly be acceptable. Your camera manual will tell you how to move the No. 85 filter out of the light path in the camera.

If you have a super 8 camera, you can use a high-speed black-and-white movie film which your photo dealer may have to order for you. Although some cameras are not designed to expose this film properly under normal lighting conditions, most cameras will give satisfactory exposure for movies of television programs. To make movies on this film, you can leave the TV brightness control at its normal setting. If you have a manually adjustable camera, try a lens opening halfway between f/2.8 and f/4 for both black-and-white and color television.

See also: DARKROOMS; MACROPHOTOGRAPHY; PHOTOMICROGRAPHY.

EXPOSURE TABLE

Film (Use)	Black-and-White Television Set		Color Television Set	
	Leaf-Type Shutter	Focal-Plane Shutter	Leaf-Type Shutter	Focal-Plane Shutter
Verichrome Pan Plus-X Pan (Black-and-White)	1/30 sec f/4	1/8 sec f/8	1/30 sec f/2.8	1/8 sec f/5.6
Tri-X Pan (Black-and-White)	1/30 sec f/5.6-8	1/8 sec f/11-16	1/30 sec f/4-5.6	1/8 sec f/8-11
Kodacolor-X (1) (Color Prints)	1/8 sec f/2.8 or 1/15 sec f/2	1/8 sec f/2.8	1/4 sec f/2.8 or 1/8 sec f/2	1/4 sec f/2.8 or 1/8 sec f/2
Kodachrome-X (1) Ektachrome-X (1) (Color Slides)				
High Speed Ektachrome (1) (Daylight)—with Normal Processing ASA 160 (Color Slides)	1/15 sec f/2.8-4	1/8 sec f/4-5.6	1/8 sec f/2.8-4	1/8 sec f/2.8-4
High Speed Ektachrome (1) (Daylight)—with ESP-1 Processing for a Speed of ASA 400 (Color Slides)	1/30 sec f/4	1/8 sec f/8	1/30 sec f/2.8	1/8 sec f/5.6

NOTE: When two lens openings are given, such as f/4-5.8, lens setting is midway between these stops.

(1) Pictures of color television taken without a filter will look blue-green. With the color films in the table, you can use a Kodak color compensating filter over your camera lens to help bring out the reds in your pictures. Increase the exposure suggested in the table by 1 stop.

How to Photograph People

The way you manage your models is the key to the results you will achieve on film

Establish model rapport with planned camera sessions in various lighting situations.

KNOW HOW TO MANAGE your models. Ignore their basic needs and you will never be anything more than a mechanic-photographer. Respond to them person to person, and your portraiture or reportage will reflect real meaning and authority.

Technically perfect shots are graphic reproductions—not alone the element which commands attention. Your photography and your models require the best interpretative expression you are capable of granting with the camera. It is all a continual, combined effort of personal management and model management, the results of which set you apart from the hack.

The absence of abundance of personal management when dealing with models is a clear issue everywhere in photography.

Professional models and professional photographers are an elite group from whom a first example can be taken. They are very communicative people. It's part of their livelihood. They understand each other because they understand the requirements of the business which brings them together. Regularly, however, top commercial illustrators have been known to mismanage a model and an expensive studio session is a flop. Therefore, even smart pros know they have to overcome natural inhibitions in all models, and they constantly work at improving their trade.

They work very hard at what is called "establishing rapport with the model." In essence, rapport is descriptive of an easy-going relationship full of harmony and accord. In practice, establishing rapport means achieving this harmony with the model quickly, overcoming the formalities of a first meeting without delay and putting the relationship (however brief) on a productive level.

By contrast, another professional level which we'll call the "Main St. Portrait Studio," is where the important principles of model-photographer rapport appear to be profitably ignored. In these storefronts repose the evidence of what may be termed the "method school"—a type of portrait product which lacks vitality, interest, personality.

Subjects are customers, not models, and they spend about as much time in this

➤ *Children are favorite camera subjects, adding spontaneity and freshness to snapshooting.*

store as they do at the corner bakery. The camera operator goes through a pat series of indifferent instructions, and the customer suffers intolerable injustices. The only "rapport" they really share is the customer's deposit.

Newspaper and magazine photographers earn credit in the way they handle their subjects.

An old pro press cameraman is perhaps one of the smartest judges of people. Although there is a great deal of method in how he has to photograph, he nevertheless imparts vitality and interest in his news pictures. He makes split-second decisions about his subject; they somehow immediately share a rapport fostered by the urgency or relative informality of a newsworthy situation. Subjects respond by being themselves.

Magazine and editorial photographers go out to the people, too. But their manner is not as matter-of-fact as the press cameraman's. Their work pace, while hurried, is rarely a same-day deadline pace. They may be guided in their assignments by layouts or artists' visualizations of how the subject should look in print. Time helps the planning.

They may plan elaborate lighting setups or deliberately simple situations. In any situation, however, their manner is always relaxed formality. The subject becomes so aware of the professionalism involved (which includes the cameraman's genuine interest) that apprehension and tenseness diminish, and he or she actually feels they are key members of the production.

No class of photography is more remiss than the casual snap-shooter. Or, the active amateur who shoots for the sake of picturing everything.

First, let's take the casual or active point of view. His photography is primarily a record of the family, friends and vacations. He uses the camera as a practical accessory in his life in much the same way he also uses a power mower, a television set or a barbecue grill. He takes a picture, gets a print back from the processor and puts it in his album. In his state, he has no real reason to be concerned about model-photographer rapport.

But not so with the serious, well-intentioned amateur—whether he is casual or active.

Those who want to improve their model management techniques have to acknowledge some basic facts. Fundamentally, the guiding rule is: models are people. To be

Older children exhibit naturalness and vitality uncommon in older subjects, making them ideal camera models.

photographed, formally or informally, is a special situation to them. They may react to the idea in a number of ways, any one of which can cause embarrassment or disappointment to subject and photographer.

One of the subject's most significant reactions to a camera is self-consciousness. One minute, your subject may be talkative and animated. Then, at the sight of the camera, he is static and unresponsive. He'll just clam up, or look silly, or do something stupid.

Usually, the unthinking photographer starts clicking away, ignoring the obvious displeasure or discomfort of the model. Under more deliberate circumstances, this is an advantage (discussed later). But in the context described here, it is willful abuse of another person's obvious distress.

For his efforts, the photographer is rewarded with stilted pictures, and a friend with strong resentments. Another significant reaction to the photographer is hostility. The person who is indifferent to having his picture taken may be only mildly amused, but the guy who dislikes the camera automatically dislikes the cameraman. This will occur even when the model agrees to a picture.

Still another reaction to the camera is the reverse attitude of the shy, withdrawn types. This person may be extroverted by nature, or he behaves in this manner to cover general displeasure. They may also know themselves to be unphotogenic, and exhibitionism is a recourse which hopefully distracts the viewer.

Serious head shots by existing light add variety and interest to a static photo collection.

Whatever the reason, this type person is risky—especially with women—and they should be avoided. They cavort or display themselves to an excessive or damaging degree. Later, the photographer is at fault for "inspiring" the situation when he should have had the good sense to put the camera away until another time.

Still, models are people, and the cameraman must take them as they come. Here are some particular situations, and how you can handle them.

Babies and children. The extent of your ability to direct and control infants and children is revealed in serious portraiture.

Forget the textbook approach. Managing infant models is strictly person to person whether you like it or not. You can't direct orders to them because they simply don't understand. All the better. You deal with them as potentially powerful subjects, and with simple trickery evoke the expression you want.

Ideally, photograph babies just after they've eaten and pottied. They're alert enough, and will not tire for awhile. Contrive any kind of blanket arrangement, well supported by bolsters or pillows, and prop them on tummies. Use noises, toys and face contortions to hold their gaze. Shoot fast —rapid fire—and expect two out of every five exposures to have merit. End the session quickly.

Adolescents take a very prideful attitude when having their pictures taken, and their seriousness should be willingly accepted. Lots of conversation, about nothing in particular, helps them to express their features —although you must be on the alert because they frequently ham it up.

Above all, don't let them take advantage of you; they will attempt to run the show if they feel they can get away with it.

Adult men and women. Many of the key features of managing men and women have been discussed earlier. Generally, men seem to think it unmanly to pose or to follow elementary recommendations which would flatter them in print. This attitude is best overcome by straightforward meetings—businesslike, cordial, brief.

There is much merit in offering a drink or cigarette (let them have a drink working off-camera) and perhaps inventing an excuss to absent yourself for a few minutes. Your absence gives them a chance to check themselves in a mirror—something they wouldn't do in your presence.

Most popular, of course, is the location portrait: the man behind the desk, the engineer in the field, etc. These portrait situations are popular because the subject is in familiar surroundings—on his own terms —and you are the visitor.

Women are always more sensible about portraits and, accordingly, more cooperative. They must be granted more than ample opportunity to look their best, and they must be genuinely flattered on their natural assets.

In formal or informal portraiture, a relaxed and naturally responsive expression is paramount. Good conversation, music, a sense of humor—all are important aids in setting up a successful session. The important feature is to start the business of taking pictures immediately. Because experience indicates a more relaxed attitude after a few exposures, many photographers "shoot" an empty camera for a full five minutes, getting the subject used to the clicking and the film changes. Soon the subject "settles-in" and most, if not all, of the exposures are acceptable.

Pictures for publication. Any of your studies intended for publication morally require the knowledge of your subject beforehand. Legally, you are also required to affix a standard form of model release to every photograph submitted for publication. This is for your protection as well as the model's. First of all, a signed model release makes it quite clear to the model that photographs resulting from a partic-

How to Photograph People *1963*

Fun-type family group photos should be a part of every photographer's portfolio.

ular session may be reproduced in any form for purposes of advertising or editorial illustration.

If you ever question the need for a model release, this is reason enough to obtain one. The only exceptions are photographs taken in the public domain, providing the subject is represented in an acceptable situation or one that would not cause embarrassment or misrepresentation. Also included here are bona fide news pictures. Photographs of nudes, semi-nudes, or partially clad persons absolutely require a form of release, even when the session is a test.

See also: CAMPING; MACROPHOTOGRAPHY.

Managing public figures for the camera is a relatively simple task, providing individuals or groups are given general camera directions.

How to Photograph Infants Successfully

By following some of these helpful hints, you can be the professional photographer in the family and turn out some shots that are truly suitable for framing

ALMOST nothing in the world is photographed more than infants. A winking camera lens is often poked at them right after arrival. And the clicking continues thereafter, reaching a crescendo at the 19-month stage. It falls off somewhat then but never stops altogether.

Why are most baby photographs so uniformly bad? One would think that, on a percentage basis alone, a lot of good pictures would result. They don't. One would also think that a camera, in the hands of a new parent, would reach new peaks of photographic inspiration. The opposite is true.

Proud of their progeny, new parents seem to tolerate just about anything. A likeness of baby—no matter how dim or shadowy the print—pleases Mom and Dad. And sadly, they inflict these second-rate snapshots on friends whose threshold of tolerance is not so high. It's also sad because, for a parent, a continuing photographic record of a child's early progress can be one of the most satisfying adventures to be had with a camera. Even the non-parent should find the subject matter fascinating and rewarding.

Wave a rattle at a baby. The baby will look toward the source of the sound. Hold out a bottle at feeding time. Baby will reach for it, mouth working in anticipation. As they probably never will again in their lives, babies respond directly to the stimuli they understand. This simplifies the photographer's job. But despite the ease of working with an infant model, the inspirational level of most photographers does not rise.

How to Photograph Infants Successfully *1965*

No one can tell you how to make a great photograph of a baby (or any other subject for that matter), but here we can state briefly the basic rules most people find so easy to forget and relate them to the job of photographing baby.

Every camera—whether it's a $2 Brownie or a $500 Hasselblad—has specific limitations. Know what they are and work within them.

Don't look only at your subject; look behind it. More good pictures are ruined because of busy or interfering backgrounds than because of the photographer's ineptitude.

Keep the composition of your photograph, the image in your view finder, as simple as possible.

Get action into the picture. Action doesn't mean activity as much as it means a responsive subject. An infant, however small, can be responsive.

Put yourself in the picture, even though you're behind the lens. In other words, try to express how you feel toward the subject. Give your pictures a point-of-view.

Even with inexpensive equipment and little experience, an amateur photographer can give heightened interest to baby photographs by telling a simple story. It needn't be complicated. And the oh's and ah's you hear when the pictures are shown will be louder and more sincere if this interest is added. Here are a few story examples:

The "baby wants bottle" story can be done in four exposures.

1) Baby cries. (It may seem heartless to be shooting pictures at such a moment but crying is a form of exercise.)

2) Baby reaches for the bottle. One suggestion: exclude the person holding the bottle. Another person in the shot steals attention from the main character and weakens the story.

3) Baby sucks its milk. By itself, this is a classic shot. The person who doesn't melt at the sight of a child taking nourishment has to be a tough one. If someone has to hold the bottle, get in close. Exclude the other person and keep attention on baby.

4) Baby sleeps. This is the logical tag to the story. The opening conflict is resolved; the story has traveled from anguish to repose.

The "baby wants baby gets" story. Five exposures.

1) Baby reaches for a rattle or other object. Try several exposures on this with baby trying from different postures (on its back, side, and stomach).

2) Baby cries in vexation.

3) Baby reaches a kneeling position for the big leap forward.

4) Baby reaches the rattle. For the sake of the story, the man behind the lens can cheat a little and help baby succeed.

5) Baby chews happily on its rattle.

The "pet gets the cookie" story. Six exposures. For this, you need an antagonist —preferably, a dog.

1) Baby is seated in a low chair. Dog is nearby.

2) Baby is given a cookie.

3) Baby munches on cookie while dog observes.

4) Dog takes cookie from baby's hand.

5) Baby cries.

6) Baby gets another cookie and both baby and dog munch happily.

The bigger the dog, the more impact this story can have. The contrast between a Saint Bernard and a tiny child, for example, would stand alone as an effective photograph.

Many such simple stories will suggest themselves. Those above are intended as thought-starters only and are not set down as classic examples of effective dramaturgy. If your own ideas are slow in coming, however, try one of them. Other ideas will surely follow.

With the right prop, one picture can tell a story. And you are ahead of the game if you do not use the obvious. For example,

1966 *How to Photograph Infants Successfully*

Capturing baby's interest with a small mirror.

She seeks approval and encouragement.

teddy bears and rattles can be used to propel a story along, but by themselves they are awfully trite.

A prop should add meaning to your picture. Say you want to photograph baby alone, seated on a chair. Use the biggest chair in the house. Its size (like the Saint Bernard) will underscore baby's smallness. And be sure to frame the shot in your view finder with the entire chair included for most telling effect.

Grandpa's watch in baby's hands has far more interest than a rattle. The watch will get response from baby and the picture will draw response from whoever sees it. What does baby think about it? Will baby drop it, eat it, or (happily) listen to it tick?

If you are frugal with film—and patient—you make every shot count and spend time and effort trying for the perfect picture. Many top photographers prefer to shoot a lot of film, however, and work for percentages. They consider ten good pictures out of 100 exposures good.

Working for the percentages has some advantages. Chief among them is the fact

How to Photograph Infants Successfully *1967*

➤ *The goal has been reached and baby has found herself a toy.*

◀ *Baby again looks up for reinforcement.*

➤ *Loses interest and crawls in search of another challenge.*

Baby munches cookie as dog sits by quietly.

Dog looks hungrily at the cookie as baby is getting apprehensive about her little possession.

Only one cookie and two hungry mouths. Baby looks to an outsider to make this decision.

How to Photograph Infants Successfully *1969*

The compromise decision, baby chooses to share the cookie.

She is rewarded with another cookie for her philanthropic decision and again munches happily.

Two good poses out of an entire roll is not a bad average. Note crop marks where photographer has chosen to cut away disturbing backgrounds.

that results are less posed. Too, there is the chance of catching the subject in an unusual, unguarded pose—that once-in-a-lifetime picture that makes people wonder "how did you catch such an expression?" Shooting for percentages is naturally costly of film and developing. But the results are often more rewarding than the patient wait and squeezing for that "perfect" picture.

Do you prefer to work with a tripod? Forget it when working with baby. If your subject is more than 5 months old and only moderately active, a tripod will impede progress. You have to be fast to get results and you need the freedom of movement you get with a handheld camera.

Hand-holding a camera imposes minor restrictions; it's chancy to use a shutter speed slower than 1/25. Many believe, even this speed is risky. At least 1/50 second is preferred for two reasons. First, you have to work fairly fast and often haven't time enough to "set" yourself to hold the camera steady enough for 1/25. Second,

How to Photograph Infants Successfully *1971*

your subject is more likely than not, to move. Do not take a chance on blurring movement.

Your other principal concern should be aperture. Indoors, a decent amount of light should permit you to open up to f/8 (at 1/50th using Tri-X rated at ASA 400). This gives the option of opening up to *f*/3.5 and using a shutter speed of 1/250. First of all, the shutter speed allows you to stop action. But just as important is the narrower depth-of-field that results. Unless you are working in a studio with a seamless paper backdrop, you are bound to have a busy background. The narrow depth-of-field blurs out the background and stresses the subject. You have to use care initially in focusing. But once your subject is in focus, it isn't going to move very far.

That, in essence, is it—a few simple suggestions to give your photographs of baby a more professional look. Try them. See if they improve your photos.

See also: DARKROOMS.

3-D Photographs through a Microscope

Tiny creatures look like science fiction monsters when viewed in stereo on photos you can take using an easily built microscope stage

Monsters, such as insect larva, are common in brooks and ponds; 3-D photographs make them vivid.

WHY BECOME a one-eyed Cyclops every time you peer at the wondrous micro-world under your microscope? Instead, why not embark on an exciting journey into three-dimensional space and see the grotesque organisms and beautiful plants as they really are—in full three dimensions!

To do this you could buy an expensive stereo microscope. But you don't have to. You can make these fantastic voyages into 3-D space with your regular monocular microscope and any camera you chance to own. There's a special advantage to probing micro-space by means of stereo photomicrographs: you and your friends can re-visit the strange, three-dimensional worlds as often as you like—long after the original subjects have been lost.

The making of stereo photomicrographs can be an exciting hobby. But there are even better reasons for making 3-D photos. You will learn more about your microscopic subjects than you ever could by normal viewing with a monocular microscope. It is often very difficult to determine where the component parts of a complex organism are oriented with respect to each other. Good stereo photomicrographs will immediately separate all parts of the subject into spacial geometry that even the least experienced person can visualize and understand clearly.

3-D optics. To understand how this type of stereo-photomicrography works, you need to know a little about the basic nature of stereo vision. The reason you normally see objects about you in three-dimensional relief is because each of your eyes sees the same object from a slightly different angle. The right eye sees a little more of the right

side of each object than does the left, and vice versa.

To see microscopic objects in stereo relief, you must similarly see two different views of the objects, but only one of the views with any one eye. The stereo microscope is built so that you obtain these two views. Do not confuse a binocular microscope with a stereo microscope. The binocular also has two eyepieces, but both deliver the same view; hence there is no stereo relief. These are used only to permit more comfortable viewing, not to obtain stereo information.

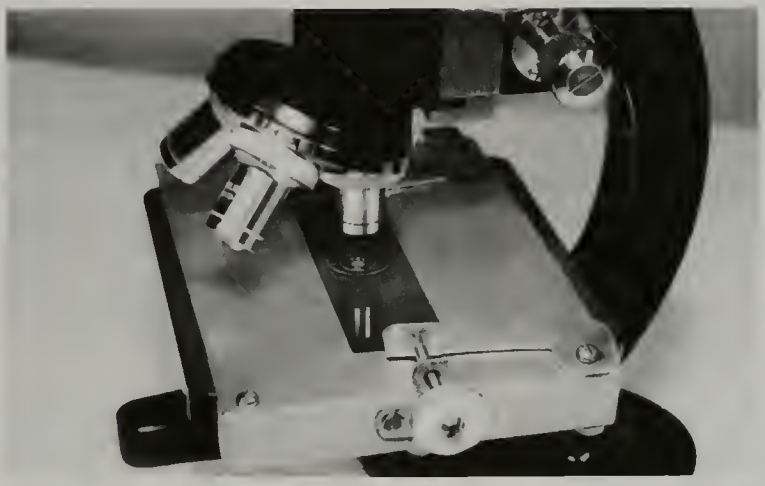
You obviously cannot look through an ordinary monocular miscroscope with both eyes at once to see the necessary two views of the object. But your camera can. The trick is to take one normal picture, then move the object slightly to obtain a second picture from a slightly different angle. When you view these two pictures with the aid of a stereoscope viewer, the two pictures will merge into one having full three-dimensional depth.

Mechanical stage. If you already own a mechanical stage, you are all set to start making stereo photomicrographs. Lacking this convenient accessory, you can easily build a perfectly adequate mechanical stage from scrap metal. You will find that this will be a very useful slide manipulator, well worth making even if you don't plan to make stereo pictures.

A homemade stage consists of a flat metal plate, preferably thick aluminum sheet, into which a slot exactly the width of a microscope slide has been cut. This slot must be cut and filed very carefully so that the glass slide will move along it laterally without any wobbling in other directions. If you cut the opening a bit too wide, narrow it down with strips of transparent tape folded over the long edges of the slot.

The fine thread bolt pushes against an upturned tab on a pivoted metal arm. A

Mechanical stages, such as this one, are line for stereo work. Also available are models with precision graduated stages.



Homemade mechanical stage is handy for general microscopy and stereophotomicrographs. A turn of calibrated knob moves lever arm sideways in the groove.

A second lever arm, fitted with spring, provides back pressure against the microscope slide. The slide moves in slot that's cut to its exact width.

tiny pin, made from a brad, projects below the surface of the moving arm to press against the left edge of the microscope slide. As the bolt is turned, the pin slowly moves the slide from left to right. Do not use a coarse thread bolt; get a bolt having the largest number of threads per inch that is available from your local hardware store.

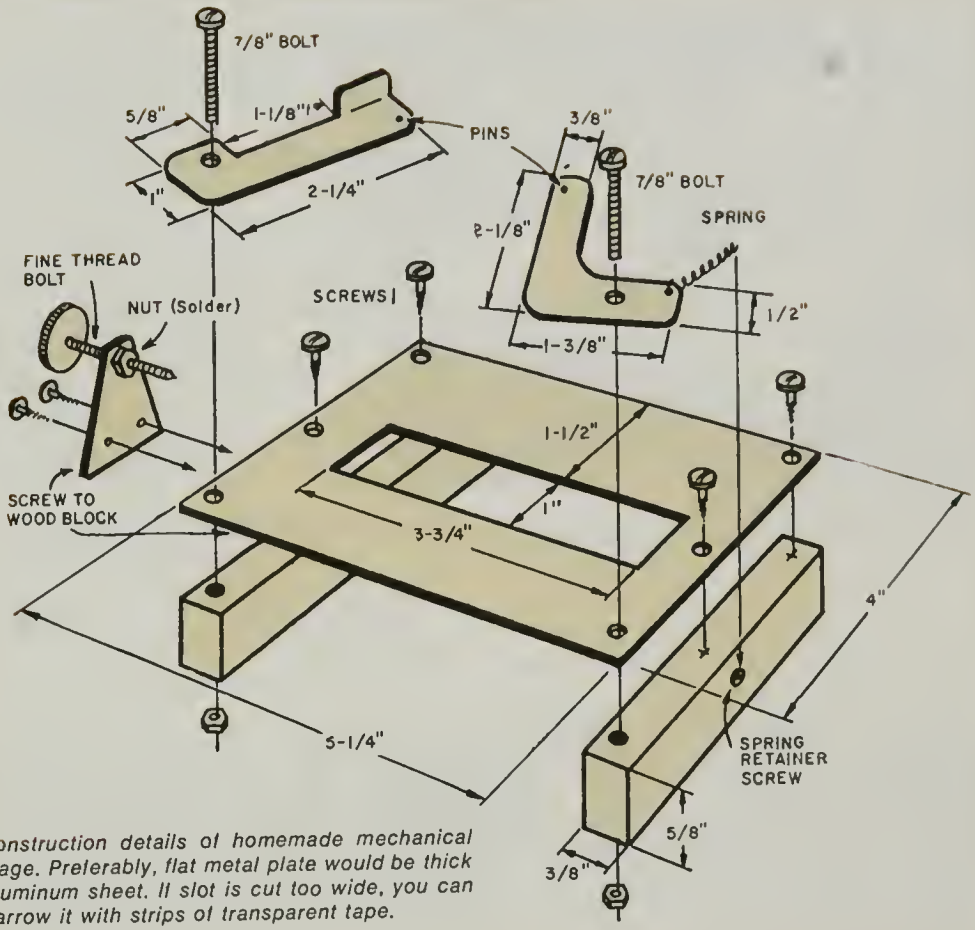
Fashion a bolt support bracket from rigid sheet metal that can be soldered. The dimensions are not critical. Make it large enough so that it can be screwed to one of the wooden bars under the main metal plate and to hold the bolt at the proper height to engage the tab on the moving arm. Drill a hole through the bracket and solder a nut over it to take the bolt.

The knob on the bolt can be made from a washer held in place with a second nut. Calibrate the outer side of the washer by dividing it into ten equal sections with the aid of a protractor.

A second pivoted metal arm having a small pin projecting from the underside is bolted loosely to the lower right corner of the stage. The spring causes the arm to press the pin against the right end of the glass slide thus providing back pressure that works against the bolt operated arm.

Cardboard stage. If the making of this

3-D Photographs through a Microscope 1975



Construction details of homemade mechanical stage. Preferably, flat metal plate would be thick aluminum sheet. If slot is cut too wide, you can narrow it with strips of transparent tape.

mechanical stage seems like too much work, you can make a crude version out of thick cardboard. Just cut the same size slot into cardboard that is fastened to your microscope stage with gummed masking or transparent tape. Mark off equal divisions along the length of the slot. Note where the corner of the glass slide is located in relation to this scale when you make the first exposure; then move the slide carefully along the slot to another position calculated to provide the proper amount of lateral movement.

Camera set-up. Any type of camera can be used to make photomicrographs through a microscope. Just rig a support of some sort that will hold the camera lens just above the eyepiece of the microscope and set the camera focus at infinity.

A press-type camera is best, if for no other reason than that you can make one or two exposures and develop the film without waiting to complete a whole roll of film. It also has a convenient ground glass for accurate focusing, and generally a bellows extension that permits you to alter the amount of magnification. When using other types of cameras, you can open the back, before loading with film, and use a substitute ground glass made from a piece of tracing

paper or artists' cellulose acetate sheet. You can also cut up a roll of film in a dark room, and load the camera with these short pieces when you just want to make one or two test exposures.

You can get extensive information about various types of equipment, suitable films, methods of development and the use of filters from standard references.

Lighting. Illuminate your subject in the same way that you would normally, using underneath lighting for transparent or translucent subjects, and oblique overhead lighting for opaque specimens. Your usual light source will be adequate for transparent subjects, but a rather strong light is needed to photograph opaque subjects.

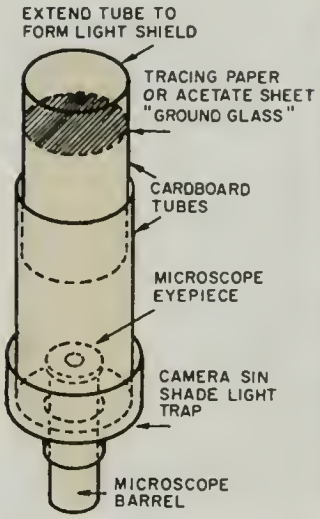
Photographic flash equipment works very well. Just set the bulb or electronic flash unit slightly above and to one side of the subject—perhaps six inches to a foot away. A tiny curved reflector made from aluminum foil, placed near the subject, will reflect back some of the light to fill in shadow areas. Strive for lighting that does not have excessively dense shadows devoid of detail. Oblique lighting on opaque specimens can be supplemented with additional light beamed up through the microscope by means of the understage mirror; this will provide a white background for the subject.

You will have to make test exposures to find out just where to place your lighting for best effect. The proper exposure must be a balance of light intensity, type of subject, film used, degree of magnification provided by the microscope and camera set-up used.

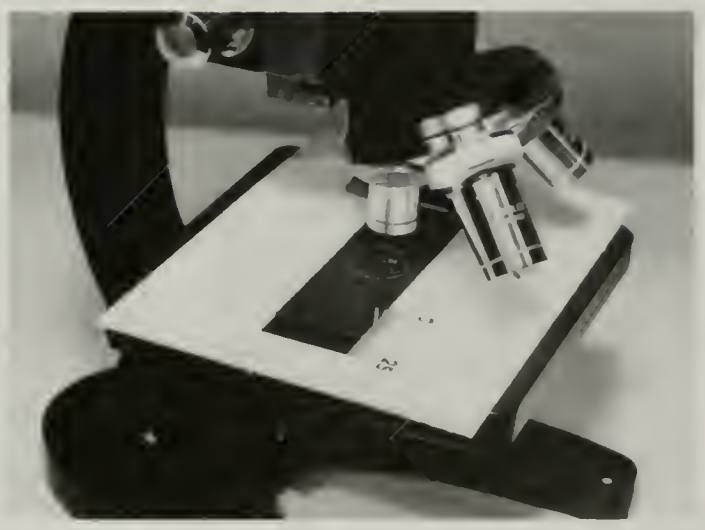
Make full use of appropriate color filters

Meters, such as these two sensitive models, help in judging exposures. Light readings are taken off focusing screen or reflex viewer. Note how two telescoping camera lens shades (one on microscope barrel) form an efficient light trap between camera and microscope. Heavy cameras need separate support.

3-D Photographs through a Microscope *1977*


EXTEND TUBE TO FORM LIGHT SHIELD
TRACING PAPER OR ACETATE SHEET "GROUND GLASS"
CARDBOARD TUBES
MICROSCOPE EYEPIECE
CAMERA SIN SHADE LIGHT TRAP
MICROSCOPE BARREL

▲ *For camera without ground glass focusing, make this for meter measurements.*



▲ *Simplest slide guide is cardboard taped to stage. Note the millimeter scale.*

placed between the light source and subject to render structural details in the subject to best advantage.

Exposure meters. You can make photomicrographs without the aid of an exposure meter provided you keep complete and accurate records of all test exposures including film used, development methods, types and positions of lighting equipment, times of exposures, and the degree of magnification. One set of data will provide you with the basic information to quickly set-up and take photomicrographs of transparent and translucent subjects; another set of data will provide the needed information to photograph opaque subjects. Begin with translucent subjects that can be illuminated by underneath lighting; these are, for many reasons, easier to handle than opaque specimens.

If you have a sensitive exposure meter that can measure very low light intensities, by all means use it. When you make your test exposures, keeping all the data records mentioned above, make light readings off the camera ground glass and at the stage. Record the brightness of the subject image on the ground glass, and also the brightness of the background area. Then, at any time you can make similar meter readings to help adjust illumination levels to obtain well exposed negatives with minimum effort. The meter reading made by pointing the meter probe down at the light source, through the stage opening, will help you duplicate the basic light intensity; just move the illuminating lamp back and forth until the meter reads what it should, according to your recorded data.

Cameras having ground glass focusing screens are very convenient because the film pack can be removed at any time, and light meter measurements can be made off the ground glass. This is not so easily done with other cameras, except when unloaded. To avoid the necessity of removing film from such cameras for the sake of making meter readings, construct a separate ground glass accessory from ordinary cardboard mailing tubes as shown in the drawing.

Cut the tube to such length that a ground glass screen made from tracing paper or acetate sheet will be held at the same height as the camera film from the microscope eye-

piece. Make the tube long enough to rest in the light collar used to couple the microscope to the camera. (This can be made from two camera sunshades of such size that the wide parts telescope into each other. The larger is mounted on the microscope tube just below the eyepiece; the other is placed on the camera in the usual fashion. One sunshade will then slip into the other to form an efficient light lock.)

A one-inch length of mailing tube, taped as an extension over the ground glass, will serve as a light shield and make meter readings more accurate.

This simple tube is all you need when using a camera with a fixed lens to film distance. If you use a bellows-type camera in which the lens to film distance can be altered, make the tube in the same way but add a length of tubing slightly larger or smaller in diameter to form a telescoping tube. This tube can then be lengthened or shortened to match the ground glass position with that of the film in the camera.

To use, simply remove the camera from the microscope and substitute the mailing tube. The image formed on the camera film will now appear on the mailing tube screen. Make the light measurements, remove the tube, and replace the camera for picture taking.

Deviation calculations. Assuming that you have worked out suitable lighting conditions and have run exposure tests satisfactorily, you are now ready to start making some stereo pictures. As mentioned earlier, you will make one picture, move the specimen slide laterally a short distance, then make a second picture.

How much should you move the slide? Actually, you could go at this more or less hit-and-miss and almost surely obtain pictures that will show the stereo effect. You might make a basic exposure, then move the slide over a millimeter or two at a time and make a series of additional exposures. At least one of the seven "second" exposures will show the stereo effect when viewed in conjunction with the first, basic exposure. In fact, you will probably find that you will get varying degrees of stereo depth using all of the possible pairs of pictures.

One pair of pictures in the series will be closest to showing the true depth dimensions inherent in the subject being photographed; the others will show either compressed or expanded depth. Which one is the correct version? More often than not you will be hard put to decide by visual examination.

A far more scientific approach to the problem is to calculate in advance what amount of slide movement, or deviation, is needed to yield true 3-D perspective. To do this, you need to know how much the subject is being magnified.

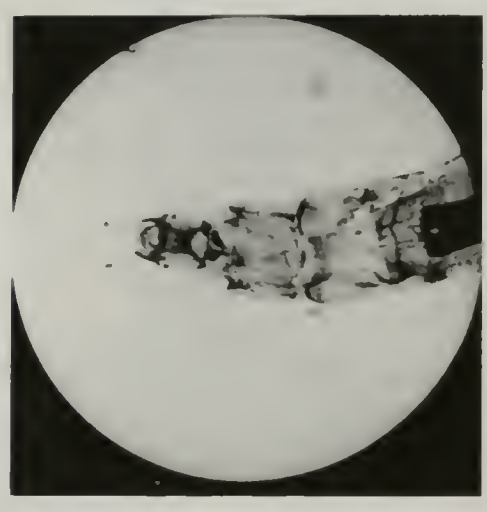
Magnification. Generally, it is not feasible to simply multiply the power of the microscope objective by the power of the eyepiece to calculate the magnification. The camera will probably alter this significantly.

The easiest way to determine the magnification being used is by using a stage micrometer. This is a glass slide with closely spaced lines etched on it. However, these are very expensive, and you can get by using a ruler having a millimeter scale, or an engineers' rule divided into 1/64ths of an inch. The millimeter scale is easier to use.

Place the scale on the microscope stage and focus onto the camera ground glass, or tracing paper taped to the film plane of the camera. Note how many millimeter divisions extend across the circular field of view, then use the rule to measure the actual field width.

For example, you might find that the field width is actually 50mm, and that the microscope enlarges the millimeter scale enough so that two millimeter divisions span the field of view. (Estimate fractions of a unit in tenths if necessary.)

3-D Photographs through a Microscope *1979*



▲ *Direction of slide movement is left to right. View at left is correct; one at right is wrong. Orient subject on slide so that its narrow dimension parallels slide movement direction between exposures.*

Divide the field width (50mm) by the visible units (2) to get the degree of magnification, in this case 25X. You need to do this only once if all conditions remain the same. But if you change the microscope objective or eyepiece to a different power, or alter the lens to film distance of the camera, you must make new measurements and calculations.

Interocular scaling. The amount the subject must be moved, in terms of the image recorded on the film, must be related to the normal interocular distance—the normal separation of the human eyes. This interocular distance is about 2½ inches or 65mm. In other words, the image on the film must be scaled down to the proper viewing angles to conform with the conditions that will be met when the pictures are viewed through a stereoscope.

To calculate the deviation, simply divide the interocular distance by the already ascertained magnification. In the example cited, this would be 65mm divided by 25 or 2.6mm. If you prefer to work in inches rather than in millimeters, divide 2.5 inches by the 25 to get a deviation of 0.1 inch.

IMPORTANT: This deviation distance does not refer to the amount the subject is moved, but instead refers to the amount the image on the camera film must move.

You can, of course, calibrate the knob on your mechanical stage in terms of image movement on the film. But you may need several such calibrations because the amount the image moves depends not only on how much the knob is turned, but also on the degree of magnification being used.

It is far simpler to set a draftsman's dividers to the required deviation distance (for example, the calculated 2.6mm) or mark a slip of paper with this interval, and place it on the ground glass of the camera. Position one point or mark on a tiny speck on the screen as projected from a dust particle on the glass slide on the microscope stage. Slowly turn the screw to shift the slide until the speck moves to the second reference mark 2.6 millimeters away. By noting how much the screw had been turned, you can duplicate this degree of shift when taking the pictures.

Taking the picture. Having predetermined the proper exposure, and having figured out the theoretically proper degree of deviation, you are ready to start making

stereo pictures. It should be obvious that this system limits you to photographing immobile subjects. Animal life must be killed or otherwise arrested from moving about.

Choose a degree of magnification that will show a fair amount of free space around the subject. If you crowd the field with the subject, part of it will move out of the field of view when you move the slide over for the second exposure.

Another tip: If the subject is longer in one dimension than another, orient it so that the narrower dimension parallels the direction of slide movement. This helps to keep the entire subject within the field of view.

Position the subject just a bit off center so that it will move toward the center during the slide shift. Focus very carefully, using a magnifying glass if you focus on a ground glass.

Make the first exposure and move the film to the next frame. Turn the stage screw slowly the pre-calculated amount to shift the subject the proper amount. Make the second exposure. That's all there is to it!

You can make some additional second exposures to obtain exaggerated stereo effects. These are often useful to gain better information about the relative positions in space of various parts of the subject. In fact, some subjects will show so little stereo effect when photographed in the theoretically correct way, that some exaggeration is needed to yield satisfactory 3-D effects. Such stereo exaggeration is quite legitimate if it provides useful information, not simply grotesquely meaningless distortion of the subject.

Making the prints. After developing the negatives, make prints in the usual way by enlargement or contact printing. Do not make them too large. You will not be able to view them if they are oversize. The width of each image should be kept under 2⅜ inches. This may consist of the entire field of view as seen through the microscope, or it may consist of a greatly enlarged portion of a particularly interesting part of the subject.

Stereoscopes. The viewing of stereoscopic postcards was a favorite parlor pastime around the turn of the century. Many of the old stereoscopes then in use are still to be found in antique shops or so-called "consignment" shops. Modern stereoscopes are available from scientific supply houses.

Cross-eyed viewing. It is quite easy to learn how to view stereo prints without the aid of stereoscopes. Place the picture pairs next to each other on a well-lighted table and stand so that you look straight down at them. Place a pencil point between the two prints. Slowly move the pencil toward your face while concentrating your attention on the pencil point, not on the pictures. You will be aware that the images seen indistinctly in the background appear to move toward each other as the pencil moves toward your face. Resist the temptation to refocus your eyes on the pictures. Concentrate on the pencil point.

When the pencil point is from one-half to two-thirds the distance to your face, the images will merge to form a stereoscopic image that seems to float in space just where your pencil point is located. If the image does not seem sharp, rotate your head slowly so that your eyes are parallel to the left-to-right line up of the prints.

To view prints in this way, the two pictures must be transposed as compared to their positions when viewing with a stereoscope. In other words, the normally left image must be placed on the right, and the right image on the left.

The trick is not difficult to learn, although it may take a bit of practice. Once you learn the knack, you can dispense with the pencil entirely.

The only drawback to this method is that the stereo image appears reduced in size. However, this is the only handy way of viewing prints that are larger in size than

▲ *Old-fashioned stereoscope (right) and modern plastic counterpart are equally good for viewing. The old one was bought in an antique shop for just $3.*

recommended for stereoscope viewing. In fact, you can make your pictures as large as 8x10 inches and view them by the cross-eye method.

The optical stereoscope is preferable because anyone can view the prints without any special training. Also, the image appears enlarged rather than reduced in size.

Print orientation. You must place the two prints of a stereo pair in the correct relative positions, side by side, to obtain proper stereo relief. If you place them backwards, you will get an inside-out stereo effect, called pseudostereo, which will appear most confusing.

Place the pictures before you so that the subject looks the same as it did when you observed it by eye through the microscope. Remember that the image on the camera ground glass is inverted; don't go by this.

The first exposure you made will be the left picture; the second picture, made after shifting the slide, becomes the right picture. Move the prints close enough together so that identical points in the two pictures are no more than 2½ inches apart. Place your stereoscope over the prints and see the stereo image.

Remember, if you try the cross-eyed method of viewing, reverse the prints so that the first exposure is on the right, the second on the left.

Mounting the prints. The preliminary viewing of the loose prints is rarely wholly satisfactory because the alignment is likely to be less than perfect. When you have picked the pairs of prints that provide the degree of stereo relief you like, mount them on stiff pieces of cardboard 6¾ x 3½ inches in size. Photographic "mat" board is excellent for this purpose. Use library paste or photographic mounting tissue.

Trim and mount the prints using either of the following two methods.

Method 1: Use this method when you want to show the entire microscope field as a circular white background. Using bits of adhesive tape, mount the prints side by side

on a drawing board, orienting them as described above.

Line up the prints very carefully with the aid of a drafting T-square held against the edge of the drawing board in the usual way. Pick several key points throughout the prints and see that they line up along the edge of the T-square as it is moved up and down.

Using the T-square as a guide, lay a long strip of paper masking tape (obtain from a paint store) across both prints so that it marks off the top boarders of the prints. This can be tangent to the circle. Similarly, lay out the bottom boarder with more masking tape, then the sides, making certain that the vertical pieces are perpendicular to the top and bottom strips and equally spaced on the two prints.

Release the prints from the drawing board and move them until identical points in the two pictures are 2½ inches apart. Check the results with your stereoscope. The subject images should coincide to form the stereo picture; also, you should see only one white circle, not two displaced circles. If all is well, trim the prints carefully along the inside edges of the masking tapes to get the clean prints, ready for mounting.

You could draw guide lines on the prints, of course, but the tape is safer because if an error is made you can strip it off for replacement without damaging the print. Also, the temporary border makes preliminary matching tests easier.

Note that when this method of trimming is used, the subject appears to float well above the white background.

Method 2: This method is used when the entire circular field of view is not to be shown. It is especially good for those prints which represent enlarged segments of the original full picture.

Tape the two prints on the drawing board as before and align them carefully with the T-square. Place horizontal strips of masking tape in position to mark off the top and bottom boundaries of the picture. A vertical dimension of about 2½ inches is the practical maximum. Now place a vertical border tape on the right edge of the left print, and on the left edge of the right print.

On the left print, locate the one part of the picture that seemed to come forward most when you first examined the stereo image. Measure from this point to the right taped edge of that print. Find the same point on the right print and locate the right edge of that print by stepping off the same distance.

The right print will now be fully framed by the masking tape. Measure the horizontal distance between the two vertical tapes on this print, and add another vertical tape to the left print to make it the same size.

Important: The masked prints should be no more than 2⅝ inches wide (they can be much narrower); otherwise you will not be able to mount them close enough together for proper viewing.

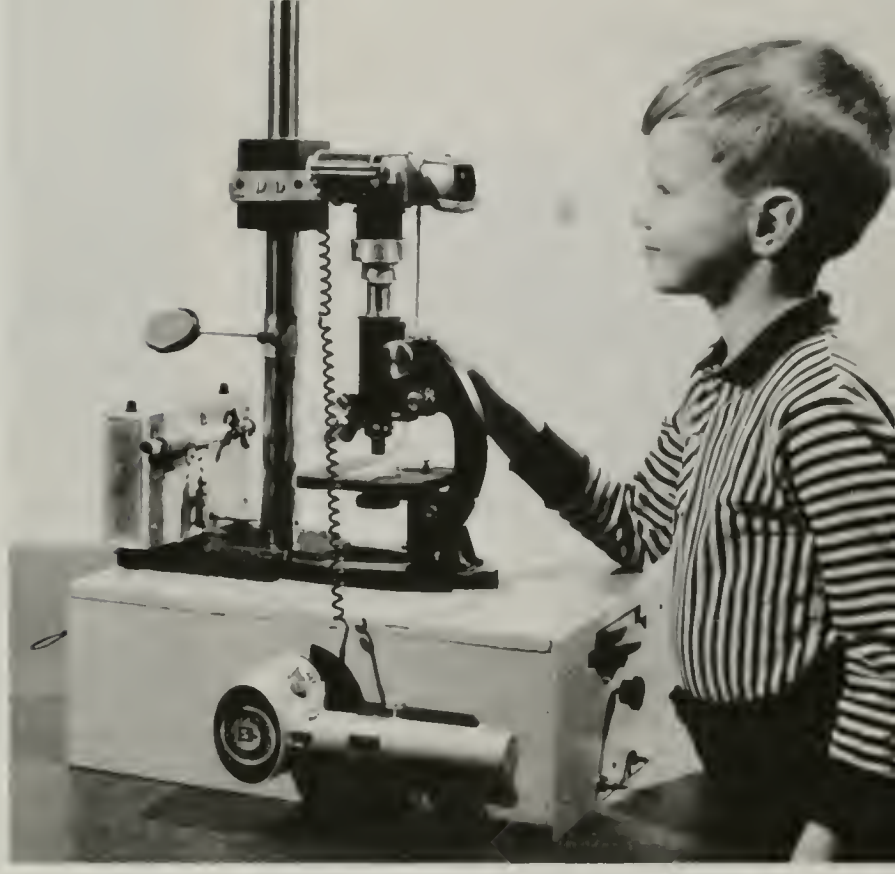
Draw a horizontal base line on your cardboard mount with pencil and position the two prints on this line so that identical points in the two prints are exactly 2½ inches apart. Mark positions, then glue into place.

Note that when you view the prints made by Method 2, the subjects do not appear to float up off the background. Instead the nearest part of the subject is at the "picture plane" which is represented by the paper it is on. The rest of the subject lies at various distances behind the picture plane. This produces the so-called window effect favored by most stereo fans. J.H.

See also: MACROPHOTOGRAPHY; PHOTOGRAPHY; SCIENCE PROJECTS.

WHERE TO FIND IT

Information about types of equipment, films, methods of development and the use of filters can be found in standard references such as *Photography Through the Microscope* by Kodak. It's available in most camera shops.



➤ *Microscope flash box in use. Single lens reflex camera, electronic flash are preferable.*

Take Electronic Flash Photos through a Microscope

How to make an electronic flash and filter system for your microscope that will enable you to freeze the action of tiny live specimens

IF YOU HAVE EVER tried to photograph microscopic forms of life with ordinary photomicrography equipment, you know it's like going after tigers with a pea-shooter. You can kill the creatures first, but you get only pictures of obviously dead animals. What you need is a high-powered, fast-acting photo-gun that captures the live ones in the peak of action. Couple your camera flash to your microscope, and you can do just that.

If you aren't a biologist, there are plenty of other types of action you can "stop" with this equipment. The dissolving of solids in liquids, fusion processes, crystallization phenomena, decomposition of substances by heat or chemical action, gas formation, flocculation of colloids, and countless other chemical and physical phenomena—all involve movement that are hard or impossible to photograph sharply with orthodox equipment. With an electronic flash and filter system attached to your microscope, it's a cinch.

The stopping of motion is just one advantage of using electronic flash. Live organisms, and many chemical/physical

subjects are sensitive to the heat of strong microscope illuminators; using flash, you can view with low-intensity, relatively cool light, but take the picture with the high-intensity flash. The flash also provides plenty of light when using dense polarizing filters, and the color temperature of the light is ideal for color photography.

You can do more than just hook a flash gun to the microscope; there's also a unique filter system which permits you to quickly dial various color filters used in black-and-white as well as color photography, polarizing filters, and neutral density filters used to control the light intensity. The entire system works equally well with transparent or translucent specimens illuminated from below by transmitted light and with opaque specimens which need to be lighted from above.

If the complete equipment exceeds your needs you can still build part of it to advantage. For example, you can build:

The completely automatic system which instantly blanks out the viewing light (to eliminate possible secondary images), trips the camera shutter and flash in perfect synchronization to take the picture, and then promptly returns the system to normal viewing conditions.

A semi-automatic system in which the camera and flash are tripped individually by manual action. Not as handy as the fully automatic system but equally capable of freezing the fastest action.

Only the filter system for efficient control of lighting for purely visual, non-photographic use of the microscope.

Only the filter system plus the opaque-specimen illuminator for more flexible light control and for projecting enlarged images onto a wall or screen for group viewing.

Basic equipment. Any microscope you happen to own can be used. Of course, the sharpness of your pictures (aside from motion-blurring which is eliminated by use of flash) depends on the quality of your microscope optics. The photomicrographs used here (they lose detail in reproduction) were made with an $85 microscope. This is inexpensive equipment compared with industrial microscopes costing hundreds, or even thousands of dollars. Actually, microscope manufacturing has improved so much in recent years that you can get very creditable pictures with still cheaper equipment.

The flash equipment shown here is a Honeywell Strobonar unit, but you can use any electronic flash unit you have simply by modifying the mounting bracket on the side. The light outputs of different makes and models of electronic flash vary, so you will have to calibrate exposures (in terms of the neutral-density filters) to fit your equipment. As a matter of fact, you can even use a reflector with ordinary flash bulbs—if you can stand the high cost of the bulbs.

The best type of camera is a single lens reflex (SLR) because it enables you to watch the microscope field up to the instant of exposure. If your camera is not an SLR, check microscope supply houses for a beam-splitter adapter; this goes between the microscope and camera to divide the emergent light, sending part of it into the camera and part to your eye through a small viewing telescope. Most microscope textbooks describe this adapter.

Of course the system can be used, without the beam-splitter, as a filtered light source for ordinary photomicrography using non-reflex 35mm camera, press cameras, or those made specially for photomicrography. You are then pretty much limited to slow-moving or stationary subjects. But even in this case the use of flash is justified because of its high intensity, economy, and because the light is excellent for color photography.

How the system works. The unit consists of a box with holes cut into each side and the top. Light from a regular microscope illuminator enters the hole on the right side and is reflected upward by a mirror—through preselcted filters set into two dials

▲ *Ammonium oxalite crystal growth "stopped"; polarized light.*

—through the top panel opening and into the microscope. This light is used for visual viewing prior to picture taking.

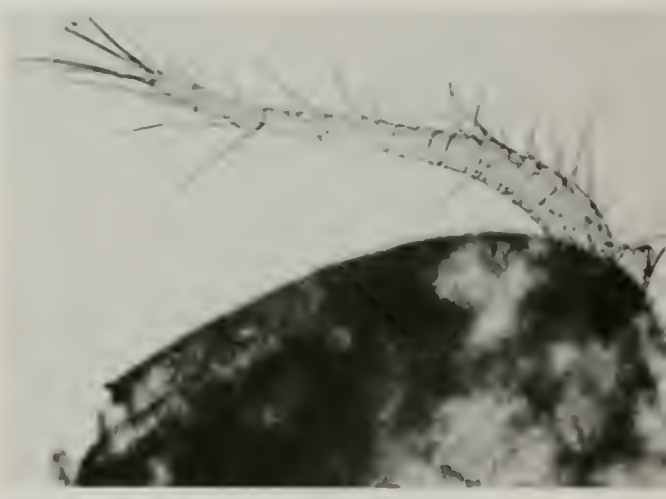
When ready to take a picture, you give the knob on the front panel a quarter turn. This tilts the mirror inside the box into the opposite direction to catch the light from the flash gun; in this position, the light from the other illuminator is cut off automatically. When the mirror reaches its maximum left position, it trips a microswitch connected to the solenoid trigger system (the cigar-box unit behind the camera support post); three flashlight batteries inside the box activate the solenoid to trip a plunger mechanism which pushes a cable release attached to the camera. The flash, plugged into the camera in the normal way, is set off by the shutter action.

When the mirror knob is released, a spring pulls the mirror back into its original position for viewing. The entire action takes only a fraction of a second.

Box construction. Begin by building the box according to the dimensions shown in the drawing using ½-inch plywood for all sides and top, and ¼-inch plywood for the front vertical panel. Make the box strong to eliminate vibrations. The top panel is fastened with screws or bolts to permit easy removal.

Cut the indicated holes on the left and right sides and on the top panel. Also cut the horizontal dial slot in the front panel (the two filter discs protrude through this

▲ *Flash photomicrograph of live mosquito larva. Microscope flash box makes an easy task of such pictures.*



▲ *Flash photo of antenna of Cyclops—a microscopic creature found in ponds and swamps.*

opening for turning, to make filter selections).

The flash mount duplicates the standard mount used to hook a flash to a press camera. The stop plate (B)—made from ⅛-inch Masonite—automatically positions the flash at the exact center of the hole each

time it is slipped onto the mount. Devise your own mounting and stop plate if you use another make or model of flash gun.

A similar Masonite stop plate (C) is fastened to the top panel. This is shaped to fit the curvature of the rear of the microscope base, and is positioned so that the microscope snubs against it to align the instrument's optical axis with the hole in the top panel.

Note the two guide blocks at the rear of the top panel. These hold down and support a sliding block on which the camera-support post is mounted. The sliding action, needed to position the camera accurately over the microscope, is especially important if you use more than one type of camera.

The two guides and the sliding block are cut from a single piece of wood. The sliding section is shortened somewhat, and notched at the front so that it can slide between the front arms of the microscope base. If you don't have a bench saw with which to cut the 60° bevels accurately, use straight-down 90° cuts and fasten flat strips of wood or metal on top of each guide so they overlap the sliding section.

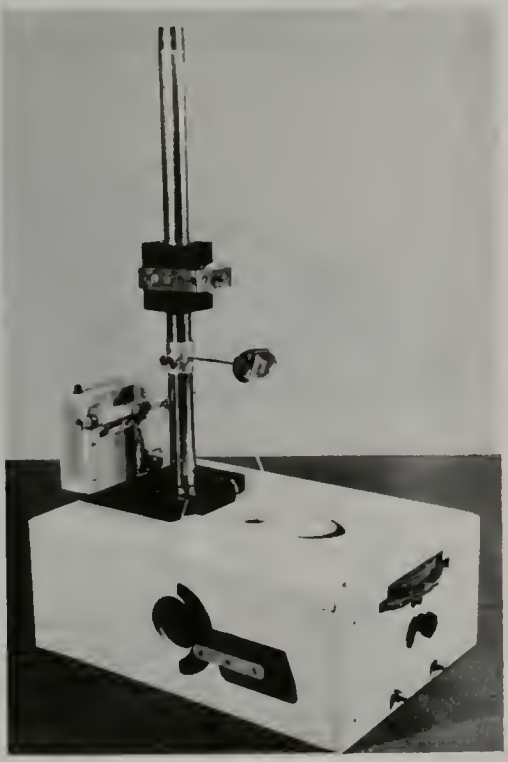
Note the lock bolt on one of the guide blocks in the drawing. The bolt goes through the guide block and tightens against the sliding block to keep it in position. The nut assembly can be made by drilling three holes along a strip of flat sheet iron and soldering a nut over the center hole; use the other holes to screw the nut assembly onto the guide block.

If you line the undercut beveled surfaces with sheet metal, the sliding action will be smoother and the lock bolt won't dig into the wood of the sliding block, but will press against the metal lining. Cut the sheet metal to fit the bevel surface, leaving a little extra length on each end which can be bent around the front and backs of the guide blocks to keep the linings from slipping out; no nailing or other fastening is needed or desirable.

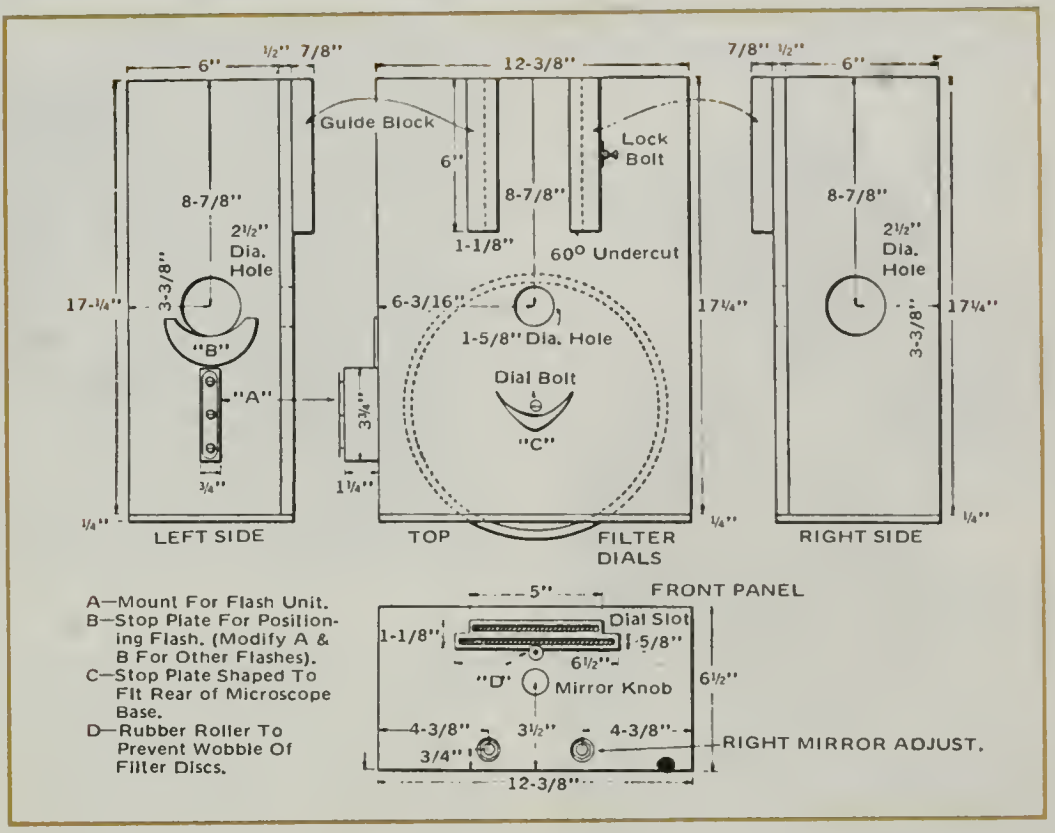
A piece of dowel about 2 inches long is glued and screwed firmly to the top of the sliding block. The steel post used to support the camera slips onto this dowel and is held in place with three screws inserted through holes drilled in the post. The post should be about 1¼ inches in diameter and at least 21½ inches long. One possibility is using a section of metal wand from a discarded vacuum cleaner, fitting the slightly enlarged end over the dowel; another section of the wand is kept in reserve, as an extension, in case a camera with a long bellows extension is used. Another type of post is mentioned in the following.

Camera support bracket. Next you need some sort of bracket to slide up and down along the steel post and hold the camera. You save a lot of work if you can dig up the easel and post assembly of an old photo-

Shown is basic unit. Mirror on post is for overhead illumination of opaque specimens.



Take Electronic Flash Photos through a Microscope *1987*



▲ *Dimensions for box parts.*

enlarger. You may even be able to use the easel as the top panel of the box.

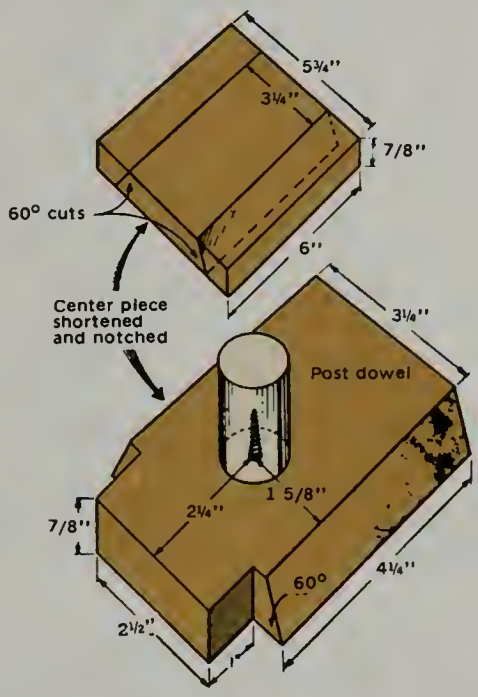
The camera support shown in the illustrations was made from readily available materials. First obtain a hardwood block measuring approximately 2⅜x2⅜x3 inches and drill a hole into it that is slightly larger than the diameter of your post. The wood surface tends to bind against the metal post even if the fit is otherwise good, so line the hole with galvanized sheet metal or tinplate cut from a can.

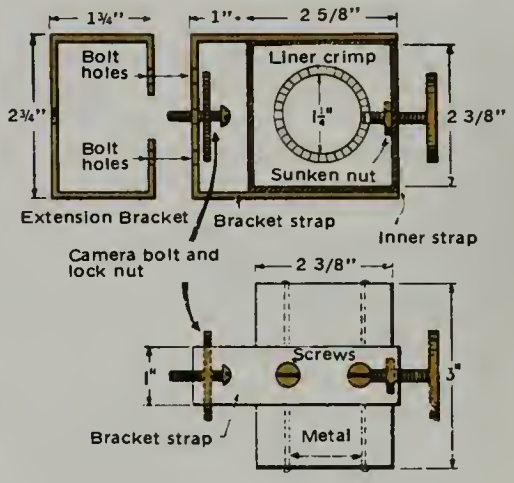
Leave a ½-inch gap at the rear of the liner so that the tightening bolt can reach the post. Also, a full liner is much harder to fit into the hole. Cut the metal liner long enough to project ⅛-inch from each end of the hole in the block of wood. Make a series of cuts along these exposed edges and bend the tabs back onto the block to form a crimped edge to hold the liner in place. Solder over the crimp makes a neater, more durable job.

Obtain some rigid, but bendable, metal strapping about one inch wide. The perforated iron strap used by plumbers to suspend pipes from basement ceiling beams is good; it also has pre-cut holes that you can use. Bend one piece snugly around the mid-section of the block, positioning it so that one hole in the straps is just where the lock bolt goes into the block. Just underneath this hole, cut a notch in the wood to hold a square nut so it cannot turn.

Make a U-shaped strap and overlap it first along the sides (not back) so that it

Guides and sliding block are cut from single piece to dimensions shown. Text gives alternate to 60° cuts indicated.





Camera support which is made of readily available materials. Plumber's pipe-suspension strap is recommended.

projects about one inch in front of the block. These two straps are screwed tightly to the block, utilizing the holes already in the strapping.

If your camera is light-weight, you can dispense with the inner reinforcing strap which is desirable if heavy cameras (e.g. press cameras) are to be supported by the bracket.

A bolt with threads matching your camera's tripod socket is fitted with a knurled lock nut (a big washer soldered to a regular nut will do); this is inserted into the middle hole in the projecting part of the U-strap to hold the camera to the bracket.

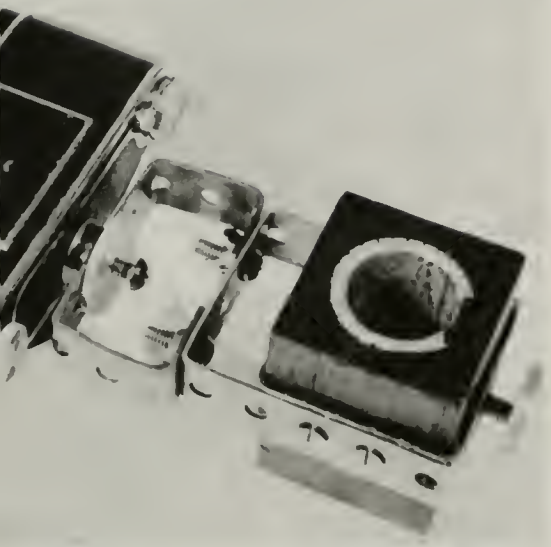
Note the extension bracket shown in the drawing. You use this when the microscope is shifted from its normal position over the light hole to permit use of oblique overhead illumination of opaque subjects. Use the same type of plumber's strapping and bend as shown. The bracket is bolted to the U-strap.

Mirror assembly. You need two rigid angle irons to support the mirror inside the box. You can use extendable brackets intended to support household draw-drape rods; these are easily extended to any desirable height. However, plain angle-irons do just as well but be sure they are sturdy and firmly mounted.

The mirror can be mounted in several ways. The front section of a photographic film-pack container can form the holder. You may find it easier to mount the mirror on a piece of plywood, and then fasten the wood to the shaft used to rotate the mirror. Mount the mirror at such height that its horizontal axis is at the same level as the centers of the holes in the box's side walls.

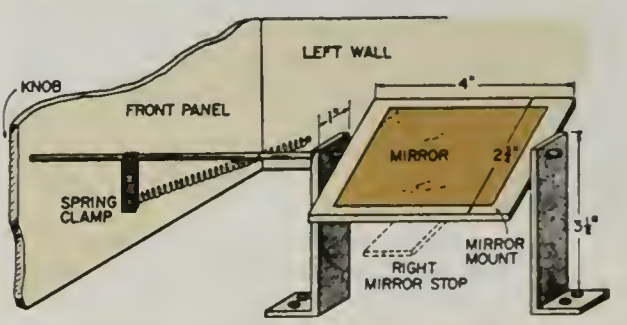
The long rod goes through the front panel, and a knob (from a radio supply store) is affixed to its end. Turning this knob tilts the mirror from side to side.

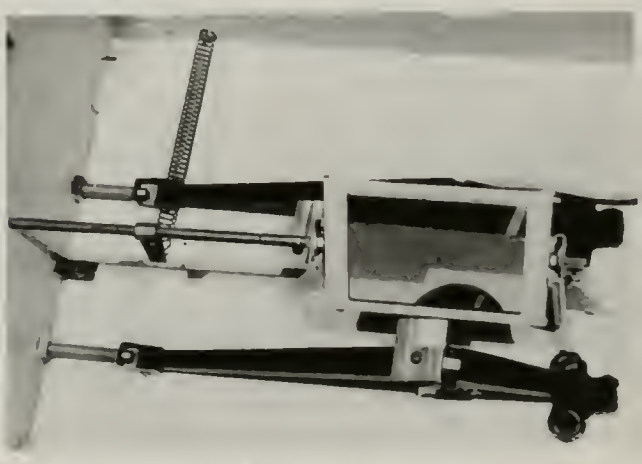
Now bend a strip of sheet metal (about 2¾ x⅜ inches) double on itself and around the mirror rod to form the spring clamp. Place a bit of rubber tubing on the rod first



As shown in the photo, camera bracket is bolted to U-strap.

Mirror assembly within the box. Rigid angle irons support the mirror. Household draw-drape rods were used.





Mirror is rotated 90° by knob at end of shaft. Spring automatically returns mirror to viewing position after each exposure. Adjustable brackets (black) control mirror position. Microswitch is on the farther arm, behind the mirror.

to prevent slippage. Tighten the clamp securely to the rod using the nut and bolt in the upper hole.

A long spring, fastened to the lower hole of the clamp, is extended to the left wall of the box. Adjust the spring tension by altering its length and by adjusting the clamp until the mirror can be turned to the flash position but so that it will promptly flip back to its original position when the knob is released. Rubber bands can be used instead of the spring, but these require periodic replacement.

The "right mirror stop" indicated in the drawing limits the right-hand swing of the mirror as described in the following.

Mirror adjustments. The illustrations show one way of making adjustable stops for the mirrors; there are many others. Although stationary stops could be used, better control of the light beams is obtained by use of adjustable stops.

One method is to make stops of two hinged metal brackets that had been used to support the end pieces of a drop-leaf table. These are easily modified to form efficient, rigid stops.

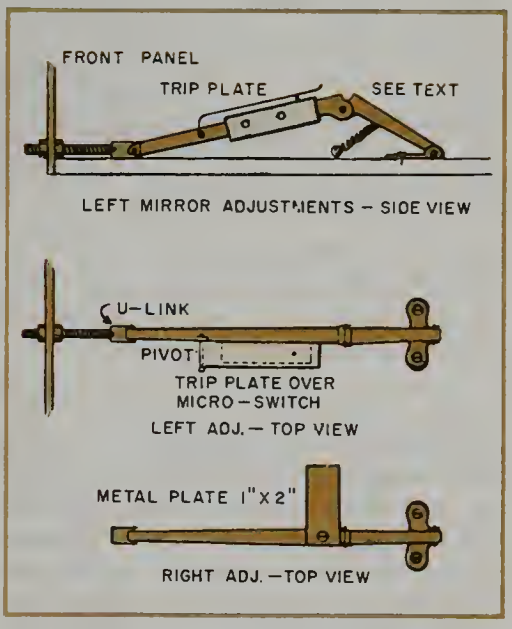
First remove the spring from the long arm of the bracket, leaving it attached to the shorter arm. The spring will be stretched to a screw-eye on the bottom of the box to provide a downward tension on the bracket. Remove the butterfly mounting piece from the long arm only, and replace it with a metal U-shaped connector made from stiff sheet metal. Bolt or cotter-pin the U link to

the arm of the bracket so that it can pivot freely.

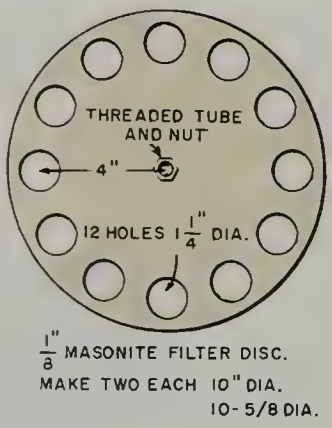
Drill two bolt holes through the front panel of the box as shown in the drawing, positioning the holes carefully so that the nuts on the bolts—inside the box—bear against the box bottom to prevent them from turning. Square nuts are better than hex nuts.

The bolts are made from ¼-inch diameter threaded rod. The inner ends are filed down to form pins that project through holes drilled into the mid sections of the U linkages.

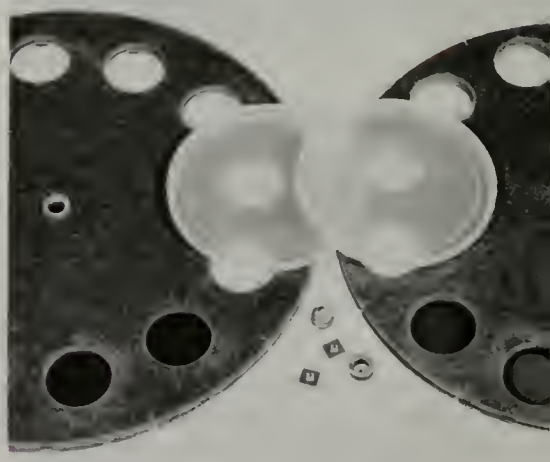
Lay the bracket assemblies flat on the bottom of the box and screw the bolts out most of the way. Fasten the butterfly mountings on the short arms to the bottom of the box and hook the springs to their respective screw-eyes. Now screw in the bolts, and the hinged brackets will gradually rise. The nuts on the outside of the box are used to lock the brackets into place when properly positioned.



For adjustable stops for mirrors, drop leaf table support brackets were used. See text for details of the modification.



As illustrated, filter system parts consist of two discs (for 24 filters), plastic coffee can lids (for spacers), spring, washer and nuts.



Both stop brackets are identical in construction up to this point; the strike plates attached to them differ. The right stop is the simplest—nothing more than a 1x2-inch rigid metal plate bolted to the high end of the long arm so that the edge of the mirror mounting strikes it.

A pressure-sensitive microswitch (radio supply store) is bolted to the inner side of the left bracket. A flat trip plate is mounted over the microswitch. This is a strip of sheet metal about ¾x3½-inch in size, curled upward slightly at one end, and rolled into a tube at the other end. A bolt

slipped through the tube section and bolted to the side of the bracket permits the trip plate to pivot up and down freely.

The purpose of the trip plate is to insure foolproof action of the tiny button on the microswitch when the mirror edge presses against the plate. A double lead wire from the microswitch terminals is run out through the rear of the box to the jack on the solenoid trigger box (cigar-box assembly).

Filter discs. Each complete filter disc assembly is made from two Masonite discs sandwiched together so that filters can be slipped between them. The two disc assemblies are of slightly different diameters.

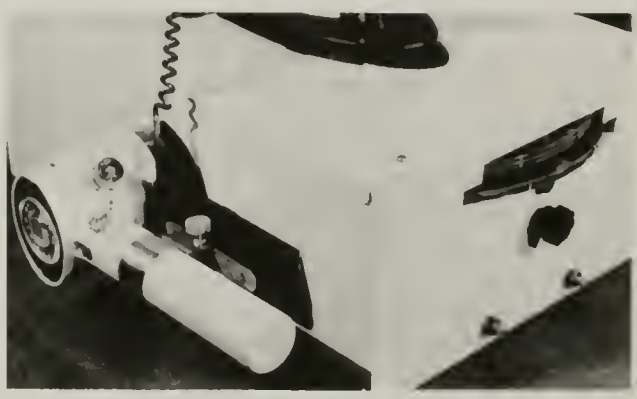
Sandwich each matching pair together (smooth sides out) and fasten at the center with pieces of threaded tubing of the type used in table lamps and other electrical fixtures (hardware or electric supply store), using very thin nuts. Radio stores have thin nuts—or you can split an ordinary nut in half and file it smooth. Use a nut on each side of the assembly, tighten firmly, cut off all extra tubing and file smooth.

If the paired discs do not lie perfectly flat against each other, use two or three small brads to hold them together. Keep the brads in the inner part of the disc, away from the filter holes.

To determine the position of the hole for the dial bolt, place a filter disc on the box so that one of its holes centers perfectly with the hole in the box panel. Mark and drill a ¼-inch hole through the box top.

Obtain a 1½-inch length of metal tubing (¼-inch O.D.) for use as a bearing sleeve around the dial bolt which should be about $\frac{3}{16}$-inch in diameter and about 2½ inches long. Insert the bolt through the hole (countersink the head) and add the sleeve, forcing its end into the hole in the box top.

▲ *Mounted discs and "click-stop" arms. Angular bend near end of each arm drops into notches on discs.*



▲ *Flash mounting and front panel. Note 2 discs, mirror (exposure) knob and mirror adjustment bolts.*

➤ *Mirror reflects light from hole onto stage for overhead lighting. Note hood, light-tight seal used between microscope, camera.*

Make two plastic spacers by drilling ¼-inch diameter holes in the centers of plastic coffee can lids. Drop one of these onto the sleeved bolt (rim outward) then add the smaller filter disc, another plastic spacer, the larger disc, a short length of compression spring, washer, and two nuts. The discs should rotate smoothly and without undue wobble.

The filter discs are a great deal easier to use if you add the simple "click-stops" shown in the photograph. Solder a short length of metal tubing to each of two 3½x½-inch strips of sheet metal to form bearing sleeves. Bend one end of each strip slightly to form a V-bump to engage small notches filed into the edges of the discs. Springs attached to the other ends of the strips provide tension to keep the strips snubbed against the disc edges.

To locate the notches on the disc edges, move the discs around to carefully center each hole over the hole in the box top. Mark these positions, and file the notches with a few strokes of a small file.

You can now place the panel back on the box by thrusting the projecting edges of the filter discs through the slots in the front panel.

Opaque specimen illuminator. Your flash unit will be far more useful if you make the simple adapter to light opaque specimens which will not transmit light. The microscope is moved to one side from its normal position over the light hole. The extension bracket shown in the photograph provides the extended reach needed to position the camera over the microscope.

Filtered light (both viewing and flash) emerging from the light hole is reflected onto the microscope stage by the adjustable mirror (use your regular microscope mirror). The mirror can be moved up and down and swiveled about to obtain any angle of lighting from a low grazing beam to a high oblique beam. The flat side of the mirror provides soft lighting; the concave side provides an intense, concentrated beam.

To make an adapter, wrap a 1½-inch wide strip of galvanized sheet iron around your camera post, allowing about ⅜-inch overlap for joining to form sliding sleeve. Tack solder lightly at this point.

Drill two holes half way down the sleeve at 90° to each other. Over one hole solder a nut for tightening the bolt. A 1½-inch length of tubing is soldered in the other hole as shown. To fasten the tube firmly to the sleeve, flare one end and flatten out to form a narrow rim that will keep the tube from sliding out of the sleeve. Drop a washer on the outer side of the tube, against the sleeve. Flow solder into the joint for a firm bond. File away excess metal and solder from inside the tube.

A 2-inch length of tubing, slightly larger in diameter, slides onto the first tube. The tube diameters are not given because you should pick them so that the pin on your microscope mirror will fit snugly into the outer tube.

Now melt the tack solder holding the sleeve in shape, re-fit around the post for a smooth sliding fit, and resolder firmly.

You can use this adapter as a handy projection device when it is not being used for photomicrography. Slide it up on the post until the mirror is directly above your microscope eyepiece (camera removed). By tilting the mirror, you can focus the microscope field in greatly enlarged size onto the room wall or a screen a few feet away for group viewing.

Solenoid trigger system. At this point (after adding filters to the filter discs) you can put your unit to use as a semi-automatic system. Simply connect the microswitch directly to your flash gun—not to the camera shutter. To take a picture swing the mirror just short of activating the microswitch to cut out the viewing light from the microscope, open the camera shutter (set to "bulb" or "time"), turn the mirror

a bit more to activate the switch and thereby the flash, and close the camera shutter. All this takes far less time than it takes to tell about it—only 2 or 3 seconds at the most.

To make your flash unit completely automatic, you should build a solenoid trigger system. The box dimensions are not critical, so long as you can fit all the parts on the outside and insert three size-D flashlight batteries inside. A cigar box will do very well, or you can easily build a box measuring about 8 x 5 x 2 inches.

(Note: This equipment could be incorporated into the large box. But if you make it as a separate unit, you may find other uses for it, as in remote firing of camera and/or flash in nature photography, etc.)

A trigger mechanism, solenoid, cable release mount, and a plate holding a small radio jack are mounted on the top of the box. One long side of the box is made removable for battery changes.

You can either buy a photographic solenoid or you can make a solenoid if you are electronically experienced. The larger radio supply houses also sell 6-volt DC solenoids for a few dollars.

The cable release can be mounted by drilling a hole into a small block of wood through which the release can pass. Mount the block onto the box, in alignment with the plunger tube. An angle iron with a U-slot holding an ordinary radio phono-jack through which the cable release can be passed will do the job.

Small jacks cannot be mounted onto plywood, hence mount the jack onto a small metal panel and fasten this to a larger hole cut into the box top.

Build the spring and plunger mechanism inside a 4½-inch length of ⅝-inch diameter BX cable conduit pipe obtainable from any electrician. Into one end solder a nut to fit a bolt about ¼-inch in diameter and about 2 inches long. Insert the bolt in the nut from inside the pipe so that the bolt head will bear against the spring. Fashion some sort of knurled knob on the other end of the bolt for easy turning.

Obtain a 2-inch length of compression spring (hardware store) to fit the inside of the pipe. Make a plunger about 2 inches long that will slide smoothly in the pipe. This can be a hardwood dowel.

Screw a wood screw part way into the front end of the plunger to form a cocking pin. This pin is easier to push if you file one side flat and solder a washer onto the protruding pin for a thumb plate.

Before adding the spring and plunger to the pipe, cut a ⅛ x ⅞-inch slot lengthwise along the pipe, about ⅜ inches from the open end. The trigger pin protrudes from and slides along this slot. Place the spring and plunger in the tube (do not compress), and locate the trigger pin about one-third of the way from the front of the slot. Insert the screw only part way as shown, cut off the head, and file the trigger bevel.

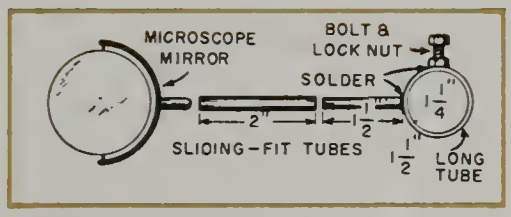
Next make the pivot-arm mounted below the pipe. Use some ¼-inch square aluminum alloy stock; round stock will do as well but is not as easy to drill.

Locate a pivot hole about midway along this rod and fasten to a U-bracket soldered on the underside of the pipe. Use a bolt or rivet of such size that the pivot action is smooth and free of wobble. The front end of the rod is filed to form the notch and front bevel. A hole is drilled nearby to take a solenoid hook made from a small nail.

Near the other end of the rod, drill a small hole part way through to hold a small spring that bears against the underside of the pipe. Alternately, use a tension spring that pulls the rear end of the rod away from the pipe.

Solder two flat metal strips, with screw holes, onto the rear of the pipe for fastening to the box top. Line up the solenoid and cable release carefully with the pipe assembly and fasten into place.

Incidentally, the solenoid "contacts" con-



Adapter construction details. It will also be helpful as a projection device.

sist of two small holes to take pin plugs. Just insert nails into these and hammer through the box; they will help hold the solenoid in place and will provide wiring contacts inside the box.

Insert a partition in the box to snugly hold the three size D batteries in place against the removable long side. Note that one battery is inverted to permit easier wiring of the batteries in series. The black button contacts should actually be small springy strips of metal fastened at one end and pulled up slightly to make good contact with the battery terminals. Wire as shown, using the protruding nail ends as solenoid contacts.

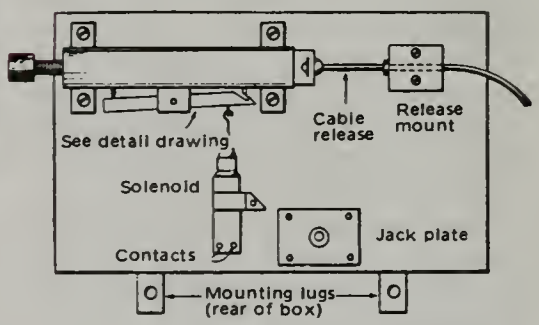
The long side of the box is kept in place with bolts (heads removed) so that the batteries may be replaced when necessary.

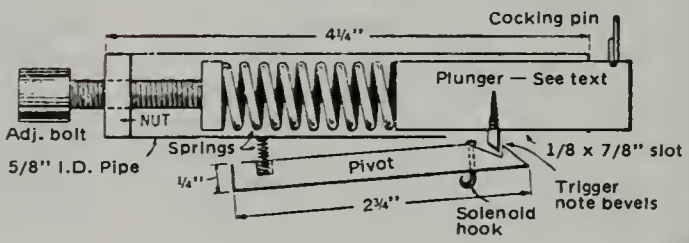
Projecting metal straps on the rear of the box are used to mount the solenoid unit onto bolts set into the rear ends of the guide blocks that hold the camera post block.

Use of solenoid trigger. Plug the wire leading from the light-box microswitch into jack on the trigger box. Screw out the trigger mechanism's bolt most of the way so there is only slight pressure against the plunger by the spring. Using the cocking pin, push the plunger back into the tube until the trigger rod catches onto the plunger pin. This action is smooth if pin and rod bevels are properly made. Fasten the cable release (it should be at least 20 inches long) to the camera, and plug the flash unit into the camera socket.

Turn the mirror knob on the light box

Solenoid trigger system. Plunger triggering mechanism is at top, solenoid below it. Wire leads to microswitch inside the main box.





counterclockwise until it activates the microswitch. This closes the solenoid-battery circuit, and the solenoid should instantly pull down on the trigger arm to release the plunger which pushes the cable release. If the shutter and flash do not operate, screw the adjustment bolt in a bit further to increase spring pressure against the plunger. Repeat this procedure until the cable release activates the shutter and flash repeatedly; then leave the adjustment bolt as is. Avoid excessive plunger pressure so that the camera shutter is not damaged.

Filter system. Use one filter disc to hold neutral density filters and the other to hold color and polarizing filters. Just slip the gelatin, film or acetate sheet filters over the holes, between the paired discs.

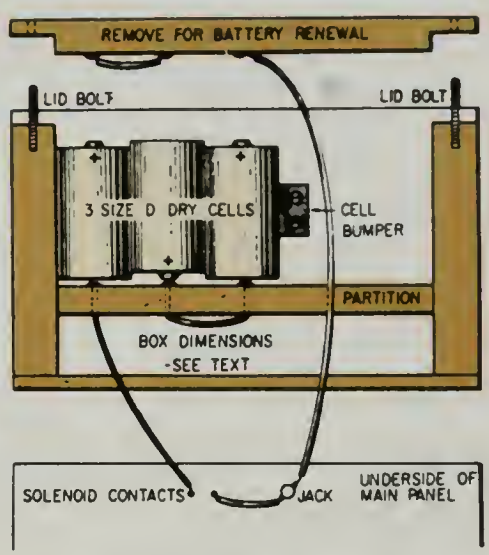
There are many uses for colored filters in black-and-white photomicrography; for example, special "M" filters for this purpose are made by Eastman Kodak.

Your photo store can obtain such filters for you (2 x 2-inch sizes are adequate). But for experimental purposes you can use far less expensive acetate filters; for example, you can obtain six 2 x 2-inch sheets (red, green, blue, yellow, magenta and cyan, a greenish blue) for less than a dollar.

A polarizing filter should be added to these. In the remaining holes you can add other experimental filters, or various light-balancing and color-compensating filters used in color photography.

The larger disc assembly is fitted with a series of stepped neutral density filters. These are grey filters which transmit varying amounts of light and are used to control the flash intensities to obtain proper exposures.

Your photo supply store can probably obtain a set of neutral density filters for you. To save money, try making your own by simply exposing black-and-white film to varying amounts of white light. Here's how:



▲ *Partition in box holds batteries in place against removable long side. One battery is inverted for easy series wiring.*

A camera loaded with Verichrome Pan film (any film would do) was pointed at a piece of white cardboard illuminated evenly with flood lamps. A meter reading taken from a standard grey card held over the white cardboard indicated that the "correct" exposure was $\frac{1}{25}$th second at *f*/8. Keeping the shutter speed set at $\frac{1}{25}$th, successive frames on the roll of film were exposed to the white card while the camera diaphragm was closed down one stop after each exposure (*i.e.* *f*/3.5; *f*/4; *f*/5.6; *f*/8; *f*/11; *f*/16; *f*/22). The film was developed to gamma 1.0.

Two-inch squares of these neutral density filters are mounted in tonal sequence in the larger filter disc. For convenience, they should be identified by ND (Neutral Density) numbers—*i.e.* ND-0 (open hole, no filter); ND-1, the lightest filter; ND-2, the next lightest, etc. These numbers are marked on the edge of the disc where they can be seen on the sections projecting from the front panel. Note that the ND numbers are not placed in front of the filters they

KODAK "M" FILTERS

Filter No.	Color	Use
38A	Blue	Increase contrast in faintly stained yellow or orange preparations. Increase resolution of fine detail.
45A	Blue-Green	Used when highest resolving power is desired, as in the study of diatom structures.
66	Light Green	Contrast filter for use with pink-and red-stained preparations.
58	Green	Contrast filter for use with faintly stained pink or red preparations.
15	Deep Yellow	For increasing contrast in blue preparations; better observation of insect details by reducing contrast between preparation and background.
22	Yellow-Orange	Uses similar to No. 15.
25	Red	Contrast filter for preparations stained with methylene blue, methyl green, etc.

represent, but on the diametrically opposite sides of the disc. The color and polarizing filters can be similarly identified with labels.

You can obtain a reasonably accurate idea of the relative light transmissions of the ND filters by placing an exposure meter on the light hole at the top of the box and reading the light values as you switch from one filter to the next. Illuminate with your regular microscopic lamp.

You can, if you wish, extend the ND grey scale further by exposing additional film less for still lighter filters and more for darker filters. Admittedly, these filters aren't as precisely density-graded as are standard commercial filters, but they serve very well after you calibrate their relative light transmissions.

Incidentally, the polarizing filter can be used alone or in combination with the ND filters for further flexibility in light control.

In fact you can eliminate the use of ND filters by using two polarizing filters—one in the disc and the other placed just above the light hole in the large box. Rotate the top polarizing filter to obtain an infinite number of transmission levels.

Remember that color filters, too, reduce light transmission by varying amounts, depending on color and density of filters used.

If you have a sensitive exposure meter fitted with a small probe you can eliminate much work and worry about relative light transmissions by reading light intensities off the ground glass viewing screen of your camera.

Aside from these suggestions, it would be pointless to talk more about proper exposures because there are too many variables. The intensity of your flash may be stronger or weaker than the one discussed here, and your whole optical system may be markedly different.

The best approach is to run a series of test exposures while keeping full records of filter combinations used, type of lighting (transmitted or overhead), type and speed of film, development times, microscope objectives and eyepieces, bellows extension if any, etc. This information will soon enable you to judge exposures accurately. J.H.

See also: MACROPHOTOGRAPHY; PHOTOGRAPHY; SCIENCE PROJECTS.

WHERE TO FIND IT

For more information about experimental filters, or various light-balancing and color-compensating filters used in color photography, see Kodak's *Photography Through the Microscope.*

Before beginning actual construction, lay out all parts to assure a tight fit.

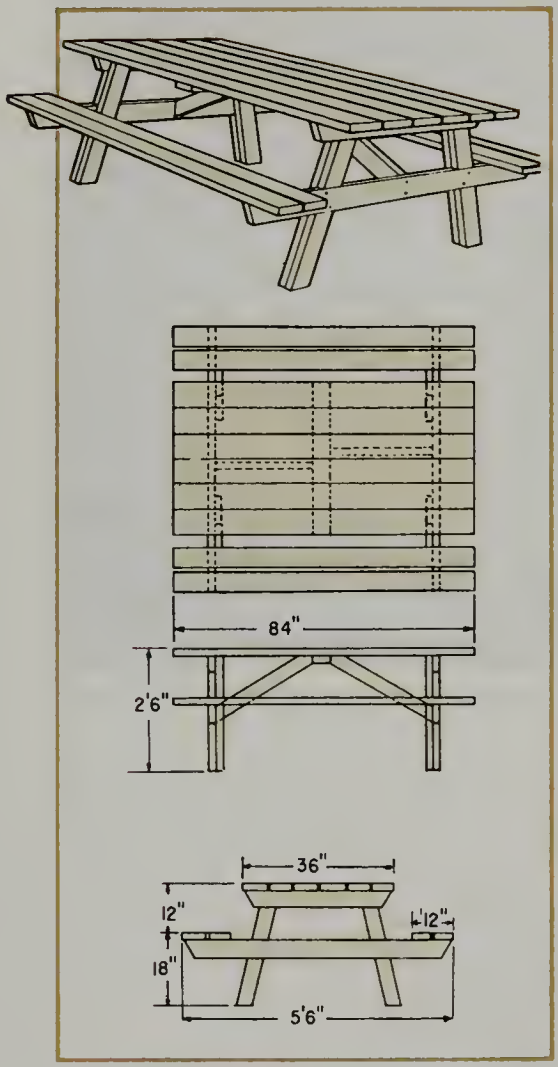
Build This Picnic Table

Ideal for families with small children, this outdoor set of furniture can be built easily in hours with just hand tools

HERE IS A COMPACT picnic group that is not only easy to move and set up, but which also takes up no more space than a conventional size table of its type. It is particularly suited for families with small children, because there are no benches for the youngsters to overturn.

By following the simplified construction plans (see drawings) you can build this outdoor set of furniture with ordinary hand tools and standard materials available at any local lumber yard. Clear redwood lumber was used to construct this group but you can also use a less expensive heart redwood grade for a more rustic look, if you wish. Weather-resistant 3-inch wood screws were used for this project, and screw holes should be drilled slightly undersize and countersunk so screw heads are below the surface of the wood. A pair of screws are used at all points.

The bench arms and the top cleats are



cut to size and end trimmed at a 60° angle, with all leg pieces cut at 75° angles. You should conduct a dry run test to make sure all the parts fit tightly before starting the actual construction.

Begin by assembling the table top, leaving approximately ⅜-inch space between the 2 x 6-inch units. The center cleat is screwed flat and the end 2 x 4-inch parts are positioned on edge 14 inches on center from the end of the table. Next, turn the top face down, since the unit is easier to assemble in an upside down position.

Construct the leg units and attach them to the top and cleats. Although easy to build, the interlocking legs and bench support with the lapped construction of the double 2 x 4-inch legs will result in an exceptionally sturdy bench and table set. Diagonal braces, cut at a 120° angle, are then screwed to the center of the leg units. Finally, right the table to its proper position and fasten the pair of 2 x 6-inch bench boards on each side.

When the group is completely assembled, round off the table top and seat corners to a 2-inch radius, then sand the entire picnic unit smooth to eliminate any danger of splinters. The redwood set may be left unfinished to weather into a soft pewter color or stained and top coated for additional protection and long life.

See also: CARTS; FURNITURE, OUTDOOR; PATIOS.

MATERIALS LIST

Quantity	Size and Description	Purpose
10	2" 6"x84" redwood	top and bench seats
3	2" 4"x35" redwood	cleats
2	2" 4"x65" redwood	bench arms
2	2" 4"x40" redwood	top and leg braces
4	2" 4"x34" redwood	legs
4	2" 4"x14" redwood	leg doubles
4	2" 4"x10" redwood	leg doubles

NOTE: Also need weather-resistant wood screws.

How to Make Your Own Picture Frames

You can make frames with specially designed stock or you can make custom shapes and sizes, such as circles and ovals, starting from scratch

FRAMED PICTURES, possibly more than any other home furnishing, allow your artistic tastes to be carried out to the fullest in decorating the rooms in your house whether they are furnished in Modern, Contemporary, Early American or French Provincial styles.

Specially designed frame stock, which can only be duplicated with expensive equipment, can be purchased at art supply and hardware stores. Tools needed for the frames you make are a circular saw, lathe, and shaper. In some instances, a drill press can be used in shaping. Shaped stock should be sanded smooth with a fine grit sandpaper before mitering and joining the pieces. Use a hollow-ground blade to cut the miters.

The most popular picture frame is the shadow box type. Shape a shadow box frame by ripping 1 x 4 pine stock to a 3-inch width, then make a shaping jig so you can pass the stock over the blade at a 45° angle and cut the cove depression so it is ½-inch from each side. The jig has a fence long enough to span the table at an angle and be clamped to the sides, an auxiliary fence 12 inches long, and ½ x 3-inch centering strips bradded to the fences.

Set the blade for a ¼-inch deep cut, position the strips at a 45° angle with the blade just touching the edges of the centering strips. Clamp the fence in place without disturbing the angle and remove the centering strips.

Form the cove depression with a series of cuts starting at table level, then raise the blade $\frac{1}{64}$-inch for each pass until a depth of ¼-inch is reached. The 2⅜-inch wide cove frame, which is off-center, is made in a similar way, except a ⅛-inch wide centering strip is attached to the auxiliary fence instead of the ¼-inch wide strip.

Ready-made shadow box frame stock usually has a 45° tilt, but when you make your own you can choose an angle any-

pipe cutters: see hand tools
planters: see brickwork
plasterboard: see wallboard
plaster patch: see patching
plastic laminates: see kitchens

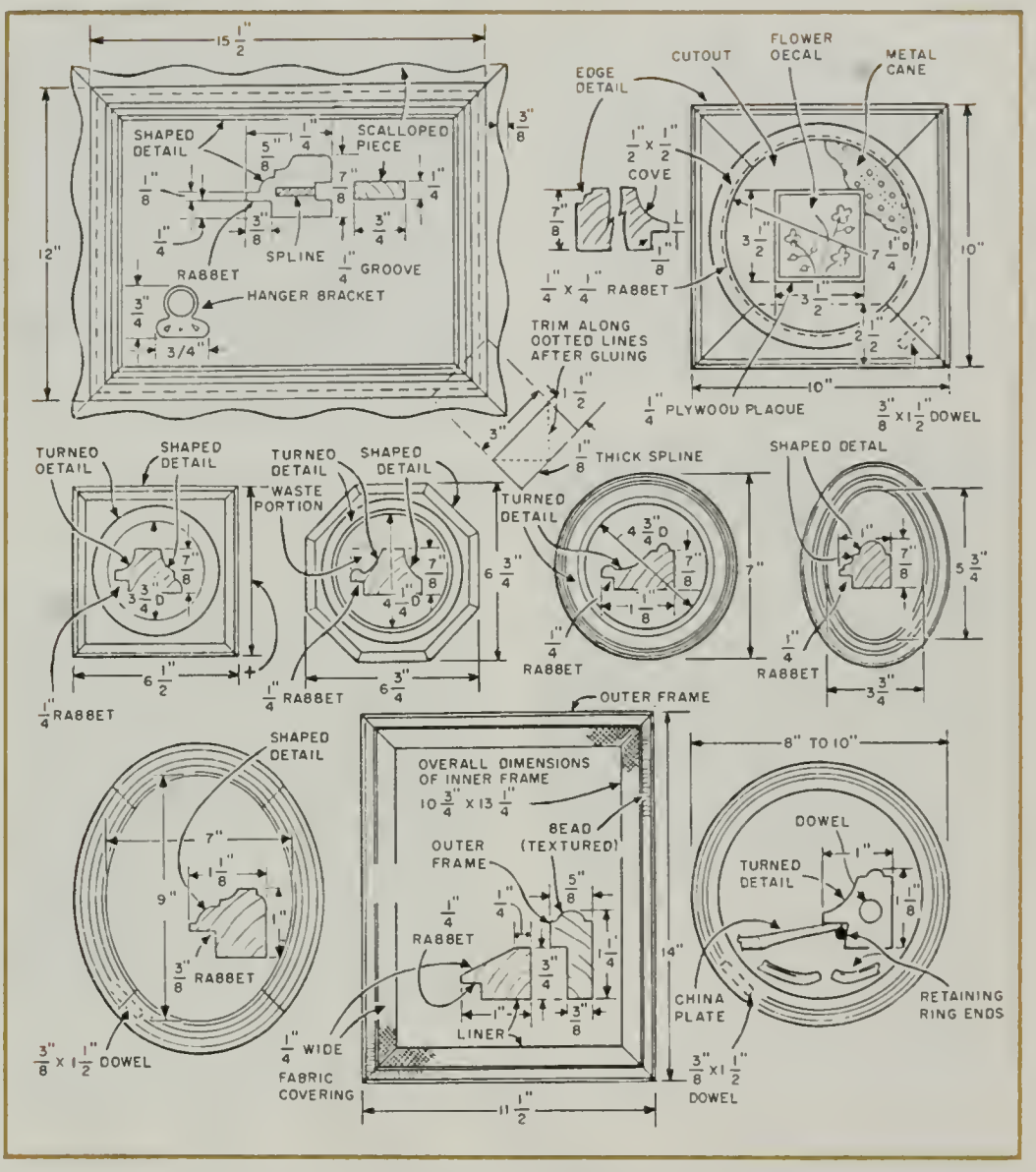
where from 10° to 45°. The lower-bevel should be made at 45° regardless of the tilt chosen. Shape detail is added next.

Undercuts should be made in all shaping operations except the top cut detail at the outside edge of the frame. When making the top cut, clamp an edge-beveled strip to the table so the stock is held in place when shaped at an angle.

Simulate wormy chestnut on raw stock by drilling 1/16 to 1/8-inch holes at various angles and at random locations. Make an etched plywood frame by gluing 1/4-inch plywood to the backing prior to cutting the miters. Because of the tilt of the shadow box frame stock, cut the miters at an angle.

Angle cutting chart shows the proper setting of the miter gauge and blade or

How to Make Your Own Picture Frames 2001

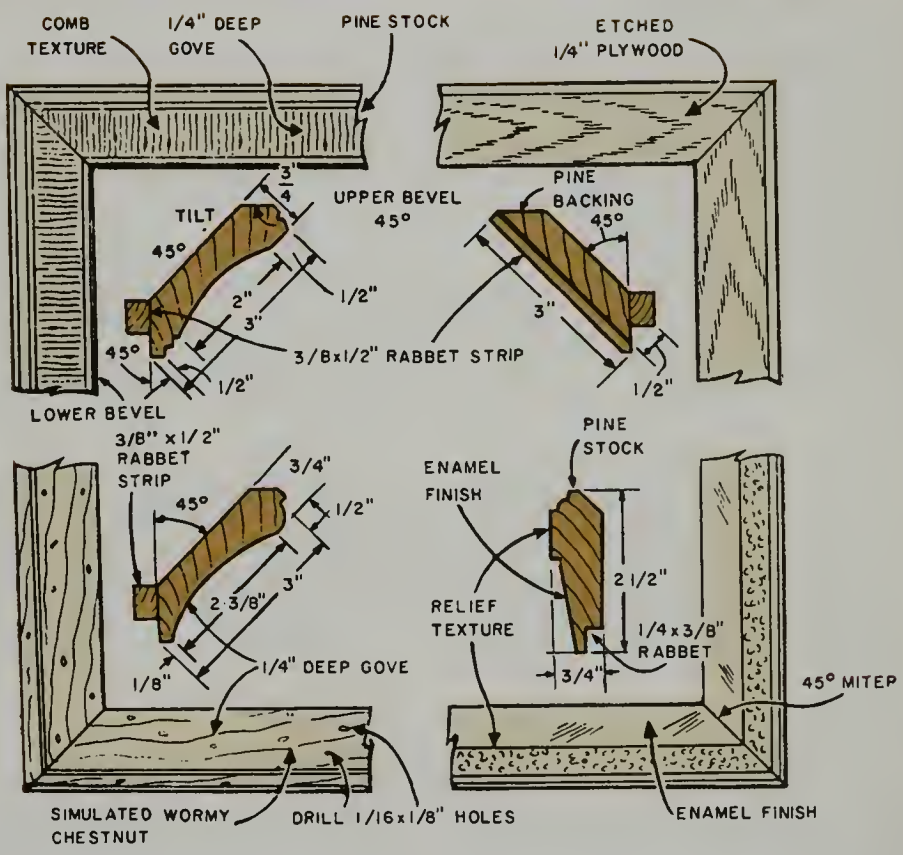


table, depending on the degree of tilt of the stock. As an example, if a 30° tilt is desired, set the miter gauge at 49¼° and tilt the blade at an angle of 21°.

Glue and nail the rabbet strips to frames, then make a frame-holding jig to help you accurately assemble the framing. Slots in the ¾-inch plywood base provide clearance for the fixed jaws of the C-clamps. The vise block enables you to hold the jig in a wood vise.

Small frames fit with practically any decor. Dimension details in the drawings are merely suggestive, and may be changed as desired. Wood glue and dowels are used to reinforce the joints.

Shape the frame stock for a scalloped frame without the scalloped trim, then mi-

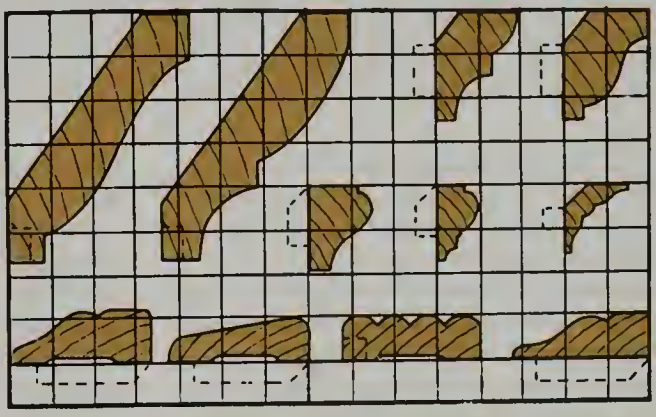


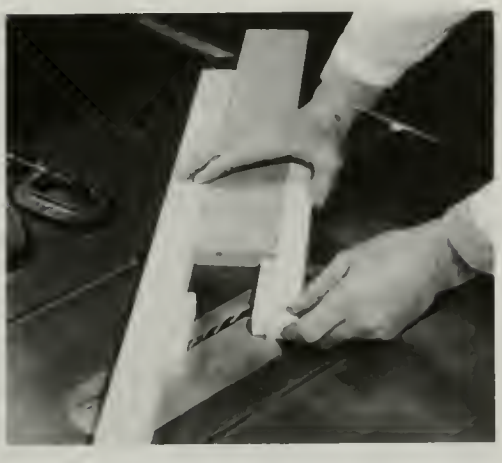
COMPOUND ANGLE CUTTING CHART
FOR CIRULAR SAW

FRAME TILT	MITER GAUGE SETTING	BLADE OR TABLE TILT
0	45	0
10	45 1/2	7 1/4
20	46 3/4	14
30	49 1/4	21
40	52 3/4	27 1/2
45	54 1/2	29 1/2

ABOVE FIGURES DENOTE DEGREES

TYPES OF STOCK MOLDINGS
1 1/2" SQUARES





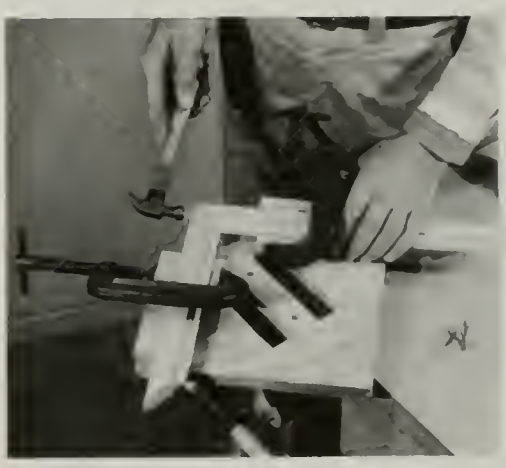
Use a shaping jig to position the stock so the cove depression for shadow box frame pieces can be formed by passing the material over the blade at an oblique angle.

Bevel the edge of the guide strip so it will support the frame stock as it is fed at an angle into the shaper to form the top cut.

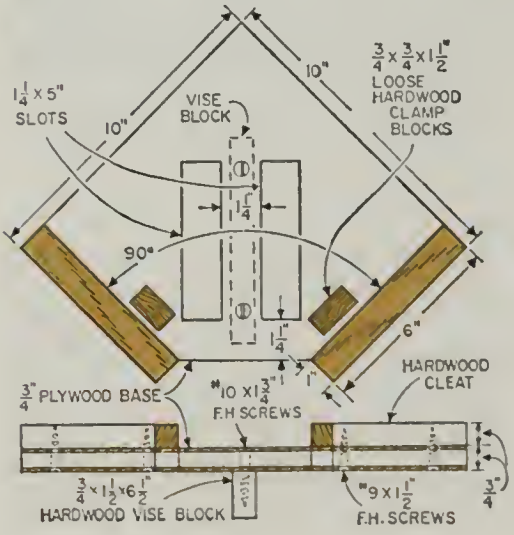
ter the ends and join two of the frame pieces. After the glue hardens, assemble a frame-holding jig and cut the spline slots. Grooves for the scalloped trim are best made with a dado head.

Use four pieces of 1 x 2½ x 10-inch stock for a small square frame with a round opening. Join the frame with grooved dowels and turn both sides until a ⅞-inch thickness is formed. Make the circular cut-out with a scroll saw, or handsaw prior to gluing the stock. The cove and rabbet are made freehand on the shaper.

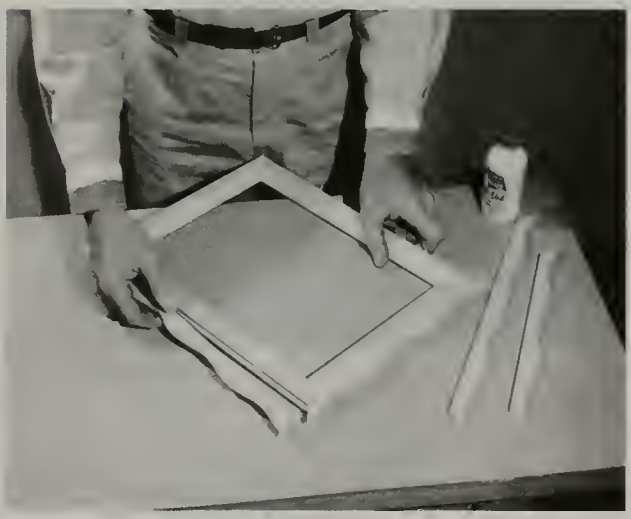
Circular detail on frames can be done on the lathe. The outer edges are fashioned on a shaper. Some frames are completely lathe turned. These circular frames are double-mounted in the lathe in the turning process. Mount an auxiliary ½ x 7½-inch plywood faceplate to the regular faceplate, and locate the work-holding screws in the plywood so they pierce the waste portion on



Vise jig holds the glued frame pieces firmly in place when the ends are cross nailed.



Frame jig assures precise alignment of spline slots in adjoining frame pieces. Stock that slides along the saw fence is 4 1/2-inch high.



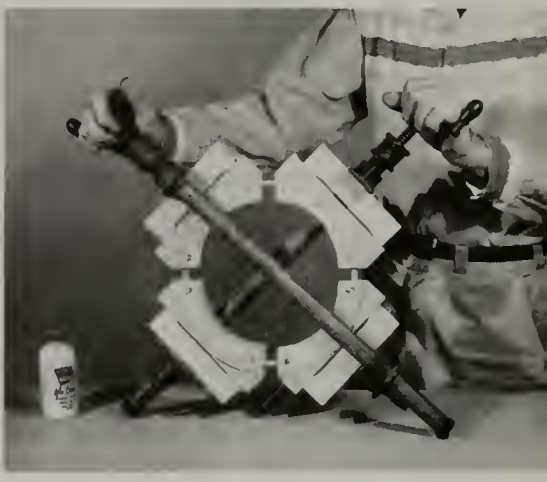
Apply wood glue in the grooves, then install the scalloped frame pieces in the openings. Careful mitering of the trim is essential for neat fitting joints.

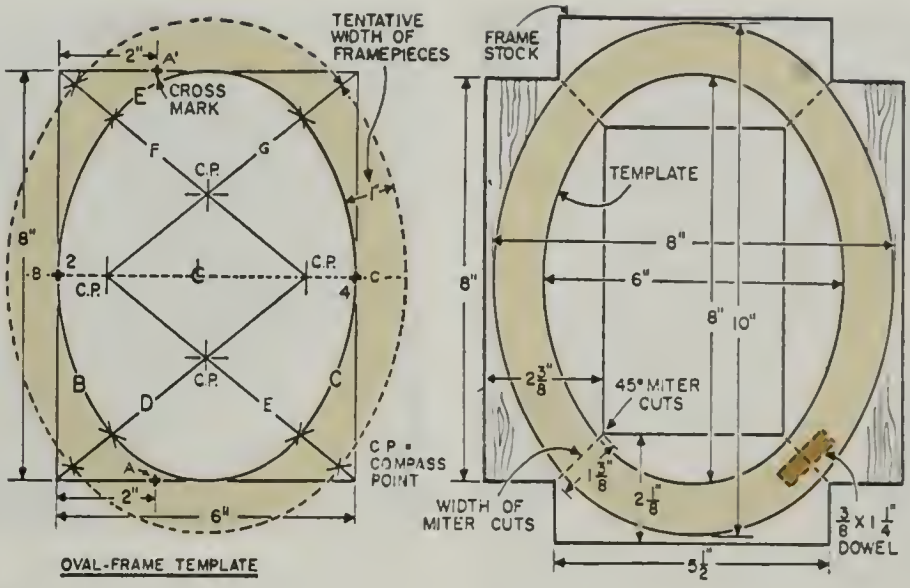
the face side of the frame to a depth not over 3/8-inch. Make the rabbet cuts first and reverse mount the work. Relocate the holding screws, then fashion the detail on the face side. When reversing the work, make certain it is centered exactly with the lathe axis.

Among the smaller frames, the oval type is one of the most popular. Some frames

Use a spur bit to bore the dowel holes in the frame pieces of the segmented frames. Mark adjoining pieces with duplicate numbers to prevent error in final assembly.

Close joints on oval and circular frames with bar clamps that are used with undercut wood blocks to bring pressure in line with joints.





can be made from a single piece of stock. Framework is made of four doweled segments to minimize warping. Use a cardboard template to lay out the frame stock.

To make the template first determine the width and height of the picture to be framed, exclusive of that part concealed by the rabbet. If the picture is 6 x 8-inch, draw a rectangle this size on cardboard and bisect with a horizontal centerline. The line should be across the short dimension. Mark points A, A′ one-third of the way in from the sides, and B, C, on the ends of the centerline. To establish the compass points on the centerline for making line A, B, A′, position the compass lead so it passes through points A, B, A′ and draw the left arc. Use the same procedure to draw the arc on the right side.

Draw diagonal lines from the corners of the rectangle to the compass points. The intersections of these diagonals gives compass points for drawing DE and FG. To draw the outside arc, determine the desired width of the frame and draw new arcs outside the original one, using the same compass points as before.

This template drawing gives the dimensions of the four pieces of stock required for an oval frame with a picture area of 6 x 8-inch. Use the same procedure to construct any other size template for an oval frame. After cutting the miters, lay the stock out and cut along the template guide lines.

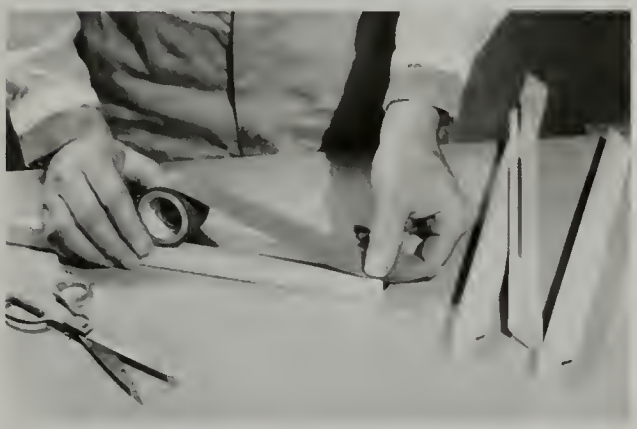
When locating the dowel holes, make certain they are placed so you won't cut into them during the shaping process. Band saw along the inner lines and clamp the pieces together. After cutting off the waste, sand the edges smooth, cut the rabbet, and add the shape detail.

One kind of frame is of two-piece construction, an outer frame and an inner frame or liner. Basic frame construction is the same, with mitered corners glued and cross nailed. Prior to assembly, apply a 1½-inch wide self-sticking fabric covering to the mitered pieces for the liner.

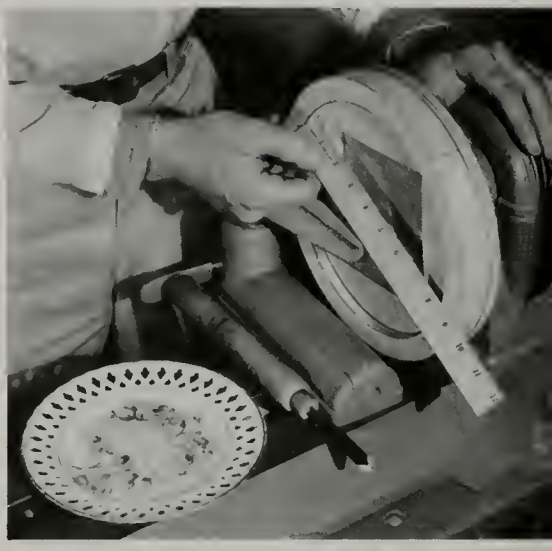
To make a frame for a china plate, cut and assemble the frame pieces in a manner similar to any frame with a circular opening. Use a circular template to mark the cutting lines, then form the rabbet and shape details on a lathe. Use an auxiliary

faceplate in the turning process. When making the rabbet, cut the side so it slants inward to secure a retaining ring which anchors the plate. Make this ring of ⅛-inch metal, and flare the ends.

A lighted picture frame can be set on a table or other piece of furniture. The light fixture is housed in a rectangular- or square-shaped bread or cake tin that is at least 2½ inches deep. Insert a tapered wood shim to bring the tubular lamp bulb parallel



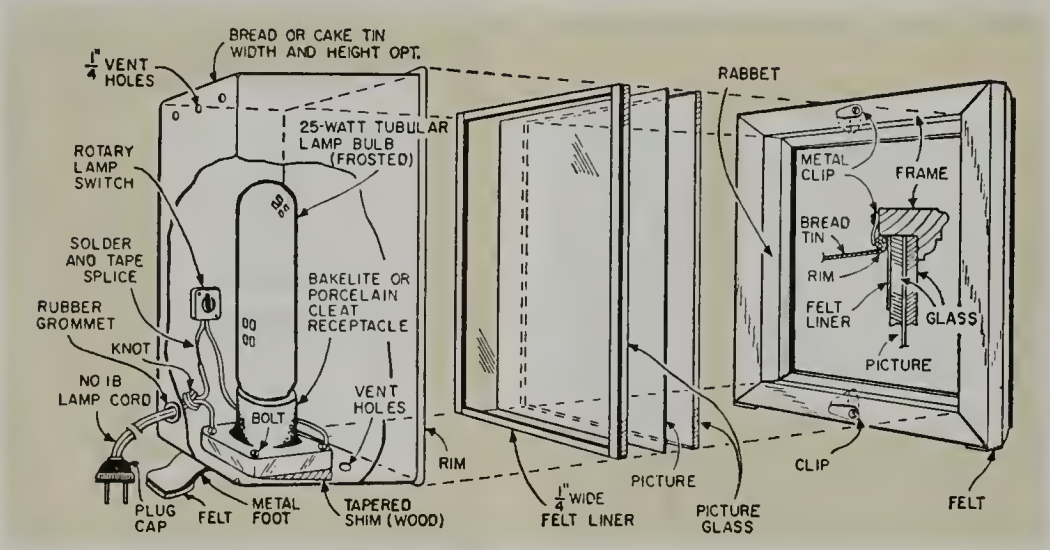
Self-sticking fabric covering on liner pieces should overhang at the mitered ends of the stock, then be folded down and sandwiched between the frame pieces when assembled.



Turn the opening so it is large enough to accommodate the plate, then cut an inward slant so retaining ring can be used to hold plate.

with the bottom of the sloped ends of the container.

Make the frame so the container rim fits a little loose in the rabbet. Small metal clips will hold the container to the frame. Glue felt strips along the edges of the rear piece to prevent glass breakage. Glue more felt to



Tape the corners of the glass to the cardboard template to prevent it from shifting when scoring the curved lines freehand.

One way to texture a gesso-coated shadow box frame piece is to scour the finish down to the wood base with a short length of comb.

the lower corners of the frame and on the metal foot attached to the bottom of the bulb container to protect the furniture top. Bend the metal foot so the frame tilts about 10°.

With a 25-watt bulb, the picture should be printed on fairly thin paper for maximum illumination. For photos on single or double weight paper, in black and white or color, a standard 60-watt bulb is recommended.

Cut the glass for oval or circular frames by placing the frame, face up, on a piece of cardboard and mark a line following the lower edge of the rabbet. Lay the glass over the marked cardboard and cut slightly inside the line. Score tangent lines on the edges of the glass, remove it from the cardboard and tap the scored area with the ball point of the cutter. Dull the sharp edges of the glass with a coarse grade of sandpaper wrapped around a sanding block.

The most popular finish for picture frames is the textured surface; it shows up best on coved shadow-type frames. Texturing material used on these frame is gesso, which has a casein base with white pigment. It is available at art stores and paint dealers.

Many interesting texturing effects can be obtained by using tools such as a comb, whisk broom, or wire brush. Pine frames are best suited for texturing. Hardwood can be finished by bronzing or antiquing. Tinted with a water color, the texturing material can be used as a filler for open grained woods.

Prior to joining the frame pieces, apply a thick coating of texturing material to the surface you want to finish. Allow it to set until it thickens, about five to ten minutes, then go over it with your texturing tool.

A relief effect is obtained by using the flat side of a ½-inch wide camels hair brush moved lightly in overlapping lifting strokes. Allow the texture to harden overnight, sand lightly with 6/0 paper, then join the frame-pieces by gluing and cross nailing.

Maple frames can be given a maple stain and finished with lacquer.

Open-grain walnut can be filled with wood filler prior to applying the lacquer

▲ *Use L-shaped pieces of cardboard to crop a scene that will be used in a square or rectangular frame. Allow for the border that will be concealed by the rabbet.*

finish. To give a laquer finish to walnut and mahogany, first apply a coat of clear lacquer sealer, then four coats of clear lacquer. Rub each coat down with No. 000 steel wool and polish the last coat to a high gloss with a paste rubbing compound or rottenstone and rubbing oil.

Corrugated cardboard can be used for backing the prints. Add a layer of heavy wrapping paper glued over the cardboard and to the frame with rubber cement, to make them dust-proof.

Select pictures suited to the room in which they are to be hung. For the living room choose prints on the restful side, such as landscapes, marine scenes, or portraits in subdued colors. Avoid flashy prints, vividly toned flowers, or other brightly done subjects which soon tend to be tiresome.

Pictures with gayer subject matter can be hung in the dining room. Flowers, still lifes, and colorful landscapes go well in this room.

Make small pictures appear larger by using a wide mat border. Margins in rectangular frames, whether hung vertically or horizontally, should be narrower at the top than at the bottom and medium at the sides. With square frames, the margins should be the same at the top and sides and wider at the bottom.

Picture size should be in proportion to the wall area it hangs on, or the width of the furniture piece over which it hangs. A small print on a large expanse appears lost, while a large one on a narrow wall appears crowded. A well arranged group of small prints can take the place of one large one.

When cropping a print for framing, use two L-shaped pieces of cardboard to help you determine the best composition. When cropping scenes, have the horizon about one-third from either the top or bottom of the print. If one or two persons are in the print, the composition is best if they are looking into the picture.

Prints not covered by glass can be protected from dust or dirt by coating with two or three coats of clear lacquer, or spray-on varnish from art supply stores. F.H.

See also: CRAFT PROJECTS; DOWELS; FINISHING, WOOD; GLASS; LATHE; MOLDINGS; TOOL TECHNIQUES; WOODWORKING.